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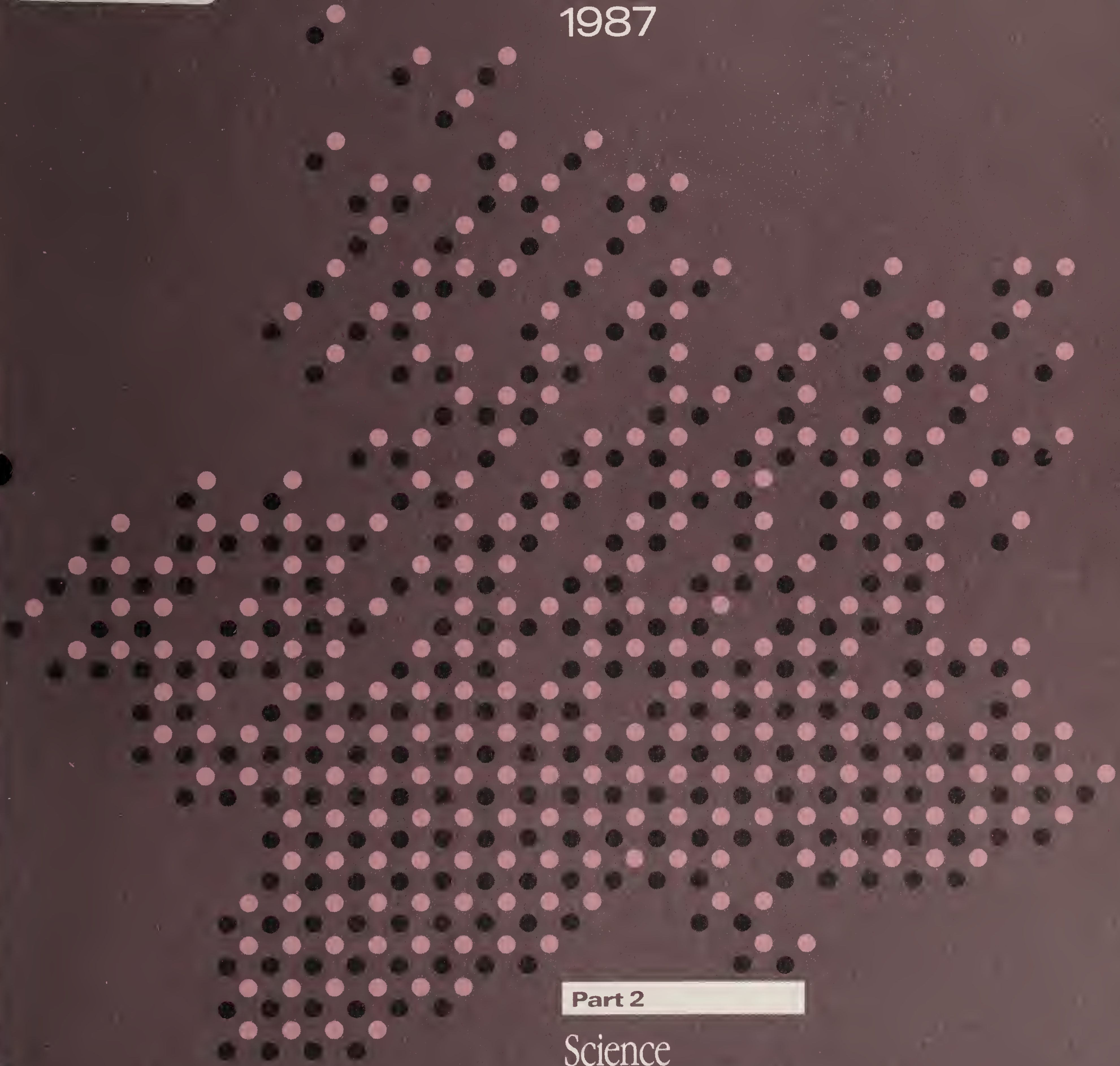
Curriculum Guideline

Science

Intermediate and Senior Divisions

1987



Part 2

Science

Grades 7 and 8

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Introduction

The Parts of the Guideline

This document is Part 2 of a fifteen-part curriculum guideline that outlines the science program for the Intermediate and Senior Divisions in Ontario schools and describes the science courses that can be offered (see the list of courses and their course codes in Appendix A). The term *guideline* refers to the entire set of fifteen parts.

This part must be read and implemented in conjunction with Part 1, *Program Outline and Policy*. When implementing the courses that are described in this document, teachers are to incorporate the many policies and features outlined in Part 1, which will enable them to interpret the overall intent and expectations of the Ministry of Education in the science program. The table of contents for Part 1 is given in Appendix B at the end of this document so that the reader may have ready access to the list of chapters and topics therein.

The provincial science program for the Intermediate and Senior Divisions comprises the courses described in Parts 2 to 15. These come under the framework and policy set forth in Part 1. The entire science guideline consists of the following fifteen parts:

Part 1: Program Outline and Policy
Part 2: Science, Grades 7 and 8
Part 3: Science, Grades 9 and 10, General Level
Part 4: Science, Grades 9 and 10, Advanced Level
Part 5: Science, Grades 9 and 10, Basic Level
Part 6: Science, Grades 11 and 12, Basic Level
Part 7: Environmental Science, Grades 10 to 12, General Level
Part 8: Environmental Science, Grades 10 and 12, Advanced Level
Part 9: Applied Biology and Applied Chemistry, Grade 11, General Level
Part 10: Applied Physics and Technological Science, Grade 12, General Level
Part 11: Geology, Grade 12, General and Advanced Levels
Part 12: Biology, Grade 11, Advanced Level, and the OAC
Part 13: Chemistry, Grade 11, Advanced Level, and the OAC
Part 14: Physics, Grade 12, Advanced Level, and the OAC
Part 15: Science in Society, OAC

The chart on the next page indicates the twenty-eight science guideline courses that may be offered in Grades 7 to 12 and at the OAC level.

Policies and Features That Apply Across the Science Program

Part 1 of the guideline specifies a great number of the policies and features that are to be integrated into the design of the science program in the Intermediate and Senior Divisions. There are too many of these to describe them in full in each of Parts 2 to 15, but the following points will give the reader some idea of the scope that is involved. They include:

- information about the science credits that are required for the earning of the Ontario Secondary School Diploma;
- a list of science courses that are prerequisite to other science courses;
- the policy regarding mandatory student activities in the science laboratory;
- a list of the aims of the science curriculum and the various emphases that may be used to blend these aims with scientific content;
- policy governing time allocations for units of study and the order in which core and optional units may be taught;
- stipulations about locally designed units;
- suggestions about preferred routes that students might take through the science program in a secondary school;
- policy regarding the introduction of non-guideline courses, which are subject to the approval of the Ministry of Education;
- recommendations related to exceptional students, individualized instruction, life-management skills, career awareness, the role and evaluation of language in science courses, and a balanced perspective on the role of both girls and boys in science;
- recommendations on the introduction and handling of sensitive issues;
- specific suggestions about resources for the teaching of science;
- ideas about different modes of delivering science courses, including the co-operative education mode;

Authorized Science Guideline Courses, Intermediate and Senior Divisions

	Basic Level	General Level	Advanced Level
Grade 7		Science	
Grade 8		Science	
Grade 9	Science (SNC1B)	Science (SNC1G)	Science (SNC1A)
Grade 10	Science (SNC2B)	Science (SNC2G) Environmental Science (SEN2G)	Science (SNC2A) Environmental Science (SEN2A)
Grade 11	Science (SNC3B)	Applied Biology (SBA3G) Applied Chemistry (SCA3G) Environmental Science (SEN3G)	Biology (SBI3A) Chemistry (SCH3A)
Grade 12	Science (SNC4B)	Environmental Science (SEN4G) Geology (SGE4G) Applied Physics (SPA4G) Technological Science (STE4G)	Environmental Science (SEN4A) Geology (SGE4A)* Physics (SPH4A)
OACs			Biology (SBI0A) *Prerequisite* – Biology (SBI3A) Chemistry (SCH0A) *Prerequisite* – Chemistry (SCH3A) Physics (SPH0A) *Prerequisite* – Physics (SPH4A) Science in Society (SSO0A) *Prerequisite – One of:* Biology (SBI3A) Chemistry (SCH3A) Environmental Science (SEN4A) Geology (SGE4A)* Physics (SPH4A)

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*Since the Grade 12 geology course described in the guideline (see Part 11) may be taught under the aegis of a geography department as Geology (GGE4A) – note the course-code change – then either Geology (SGE4A) or Geology (GGE4A) may count as a prerequisite to Science in Society (SSO0A).

- policy pertaining to the significant role to be played by measurement and metric units in science courses;
- stipulations related to the treatment of symbols, significant digits, and mathematical problem solving;
- recommendations concerning the roles to be played by calculators and computers in science courses;
- specific directions about safety;
- policy and principles pertaining to the evaluation of student achievement;
- policy regarding differences in the treatment of science courses at the three levels of difficulty;
- many suggestions about implementing the science program.

It cannot be emphasized strongly enough that teachers of science must integrate the policy and recommendations outlined in Part 1 with the teaching of science and cannot simply rely on the course descriptions given in Parts 2 to 15 of the guideline.

The Intermediate Division Continuum

The two courses Science, Grade 7 and Science, Grade 8, together with the science program of Grades 9 and 10, form a continuum that is intended to help students see something of the panorama of science, enjoy the subject, and appreciate its application to their lives and to society in general. This four-year continuum should also prepare many students for further studies in science in their Senior years.

During the Intermediate years the program is intended to provide a diversified approach to the science disciplines and to build on the more unified approach that is characteristic of the Primary and Junior years.

Grades 7 and 8 provide students with the opportunity to work for short portions of each course in each of the disciplines: biology, chemistry, physics, and environmental science. This *mosaic* permits variety and diversity, but also allows students to note interrelationships among the sciences.

All teachers of science in the Intermediate years should have some familiarity with the subject matter contained in the science courses that they do not teach so they can minimize overlap among the courses and ensure that continuity is provided.

In Grades 7 and 8 teachers will have to be sensitive to the varied needs and abilities of students and adapt the science courses accordingly. Some students may benefit from a special tailoring of, or even the omission of a topic or two in, a unit of study; others may require a moderate to complete treatment of the unit; and the most capable may benefit from some enrichment through the possible extensions of the unit.

In both courses the core units and the prescribed number of optional units are to be included. The time allocation for each unit of study should act as a guide in helping teachers devote a proportionate amount of time to each of the units in a course. This is important in view of the continuum from one course to another.

The Grade 7 and 8 science courses, particularly the core units, provide an important preparation for science in Grades 9 and 10, which is usually offered at the basic, general, and advanced levels of difficulty, as well as for environmental science in Grade 10, which may be offered at the general and advanced levels.

Required Courses

In each of Grades 7 and 8, students are required to take a science course having instructional time of at least eighty hours. Many of the units of study in these courses are closely related to similar units in Grades 9 and 10. It is anticipated that most of the students in Grades 9 and 10 will take science, since two science credits are required within the compulsory subjects needed for the earning of the Ontario Secondary School Diploma. It is therefore necessary for teachers of Grade 7 and 8 science to examine Grade 9 and 10 science units that are related to Grade 7 and 8 units to ensure that thorough preparation is provided and that there is no undue encroachment on the secondary school work.

Curriculum Emphases

It is recommended that teachers organize each of the courses described in this document around a particular curriculum emphasis or set of emphases. Such emphases give the curriculum a special focus that can be introduced in addition to the content and processes outlined in the courses. This approach is discussed in subsection 3.4, “Curriculum Emphases – Blending Curriculum Aims With Content”, of Part 1 of the science guideline. In table 2 of that subsection a list of emphases is given. These emphases will enhance the development of the science courses described in this document. A particular emphasis that is stressed throughout an entire course or for one or more units at a time needs to be highlighted so that it becomes a focal or integrating theme.

Student Activities

In each unit of study there is a section entitled "Student Activities". This section indicates the *mandatory* laboratory activities required of students. Teachers may substitute *equivalent* laboratory activities where appropriate. Those activities that are actually to be performed by students themselves are marked with asterisks. If time and circumstances permit, the teacher should encourage students to do some or all of the unmarked activities as well. However, such activities may be demonstrated by a student or the teacher or may be discussed in conjunction with a textbook, film, computer program, or other learning material used as a resource. In any event, the scientific concepts and principles related to such unmarked activities and identified in the objectives of the unit of study shall be considered to be part of the prescribed course.

Generally, the best approach to the teaching of science is to ensure that the content develops directly from related student activities. In each unit of study the skills and processes of scientific work should be presented as the central component, from which the subject matter, applications, and implications emerge.

Safety

Safety awareness must be developed in all science students. Constant attention to accident prevention is to be stressed in all student activities and teacher demonstrations in the laboratory. Section 9, "Safety", in Part 1 of the science guideline contains the following comprehensive subsections:

- Safety in the Laboratory
- Some Recommended Safety Procedures
- Animal Care in Science Courses
- The Safe Use of Plants

In each unit of study, subsection 6, "Safety Considerations", acts as a reminder of some of the safety features that pertain to the unit in question. General reference, however, should constantly be made to the safety section in Part 1. Schools must always remain on the alert in regards to safety and maintain an up-to-date safety-awareness program.

Sensitive Issues

The curriculum outlined in this science guideline places a distinct emphasis on the science-technology-society connection. For this reason scientific applications and societal implications are mandatory components of each unit of study. In addition, Part 1 of the guideline underlines the need to incorporate morals/values education in science courses. Undoubtedly, this will give rise to the discussion of some sensitive issues.

Such discussions are important. Generally, they should be focused and should provide an open forum for the expression of different viewpoints. In this regard teachers of science are urged to familiarize themselves with section 10, "Values in Science Education", of Part 1 of the guideline and to pay particular attention to the principles to be observed when dealing with sensitive issues in the science curriculum. These principles are mentioned in subsection 10.2 of Part 1.

Locally Designed Units

Among the optional units in each of the courses described in this document is one entitled "Locally Designed Unit". Such a unit is included to allow teachers, at their own discretion, either to introduce an appropriate new area of science not described in the guideline or to include additional new work that will expand on previous parts of the course.

Evaluation of Student Achievement

In each unit of study described in the courses outlined in this document, subsection 5, "Evaluation of Student Achievement", specifies certain items that must be included in students' term marks (exclusive of formal examinations) when their achievement is evaluated. In most units teachers are required to evaluate students' activities and related laboratory reports. However, the proportion of the mark assigned will vary from one teacher to another. In order that the experimental component of science be emphasized, the overall mark for an entire science course must include at least fifteen per cent for the evaluation of student achievement in laboratory skills and reports.

Cross References

In the descriptions of each unit of study in the courses outlined in this document, cross references are provided in parentheses. These are included to provide some examples of the relationships that exist among the parts of the unit.

Particular Features of the Grade 7 and 8 Science Courses

Units of Study and Their Time Allocations

The following charts provide an overview of the units of study in Grade 7 and 8 science. They also indicate the time to be allotted to each unit.

Science, Grade 7

Units of Study		Time Allocations
Core		
1. The Nature of Science		16 h
2. Characteristics and Classification of Living Things		16 h
3. Properties of Matter		16 h
4. Conservation of Energy		16 h
		64 h
Optional		
One of:		
1. Chemicals	16 h	16 h
2. Plants in Our Lives	16 h	
3. Science Project	16 h	
4. Locally Designed Unit	16 h	
		80 h

Science, Grade 8

Units of Study		Time Allocations
Core		
1. Solutions		16 h
2. Investigating Living Things: A Process Unit		16 h
3. Force, Work, and Energy		16 h
4. Soil and Plant Ecology		16 h
		64 h
Optional		
One of:		
1. Heat and Temperature	16 h	16 h
2. Adaptations	16 h	
3. Science Project	16 h	
4. Locally Designed Unit	16 h	
		80 h

Balance Over the Two Courses

The core units in these two years provide a balance among biology, chemistry, physics, and environmental science. The selection of an optional unit in each year can complement the core units and be tailored to student needs, teacher expertise, and the local context.

Another form of balance that must be planned is that between content and process. While subject matter is important, hands-on experiences must also constitute a major component of these courses. Students should become familiar with many scientific skills prior to entering the secondary school program. Their development of such skills should be evaluated.

The Nature of Science

Each course described in this document contains a unit that specially focuses on the unique nature of science in the investigative sense – core unit 1, "The Nature of Science", in Grade 7 and core unit 2, "Investigating Living Things: A Process Unit", in Grade 8. These two units are intended to provide students with an understanding of the way in which scientists work and of the manner in which processes are used in scientific endeavours.

In each of the Grade 7 and 8 science courses, there is also the opportunity to include optional unit 3, "Science Project". This unit is described fully in the Grade 7 course description, and this description applies to the Grade 8 unit as well. While this kind of unit will involve some science content, the major intent is to increase students' skills in the use of scientific processes and problem solving. The problem solving should include qualitative and quantitative aspects.

Metric Units in Grades 7 and 8

Subsection 8.2 of Part 1 of the science guideline contains a list of metric units with which students are expected to be familiar by the end of Grade 8. Teachers of science and mathematics in Grades 7 and 8 should co-ordinate their work to ensure that this objective is achieved.

Science, Grade 7

Core Units

The Nature of Science
Characteristics and Classification of Living Things
Properties of Matter
Conservation of Energy

(64 hours)

Optional Units

Chemicals
Plants in Our Lives
Science Project
Locally Designed Unit

(16 hours)

Core Unit 1

The Nature of Science

Time: 16 hours

An integral component of the total science program is the development of students' understanding of the nature of science. As students practise the processes of science and study the products of scientific endeavour, they should realize that science is a highly specialized field of knowledge, which is subject to errors and limitations. They should also become familiar with the applications of science and related societal implications.

Although the content will vary from one unit to the next, an understanding of the scientific method and its associated skills will provide continuity to the program and facilitate the application of learning processes beyond the science classroom. The strategies and activities developed around each topic should provide an introduction to the nature of science and the importance of the scientific method of problem solving.

This unit may be divided into topics such as the following:

- The nature of science
- Observations and inferences
- Scientific problem solving or the scientific method
- Scientific models
- Contributions of Canadian scientists
- Science, technology, and career opportunities

1. Objectives

Attitudes. Students will be encouraged to develop:

a) curiosity about everyday happenings in their immediate environment (2b, 2e);
b) a willingness to use scientific skills to solve problems (2d, 2e, 3, 8c);
c) open-mindedness in searching for potential solutions to a defined problem (2c);
d) critical-mindedness in evaluating the outcomes of a scientific investigation (2c-2e, 3, 8e);
e) pride in the achievements of Canadian scientists (2f, 8d);
f) an appreciation for the ability of science to explain common everyday events (3, 8c, 8e);
g) honesty and perseverance in completing a problem-solving activity (2c-2e, 8a, 8b, 8f).

Skills. Students will have the opportunity to develop skill in:

a) distinguishing between an observation and an inference (2b, 2c);
b) describing observations in words as well as by means of tables and graphs (2b, 2c);
c) suggesting questions for the investigation of a particular topic introduced by the teacher; for example, in response to observing the motion of a model propeller-driven airplane, a model helicopter, or a falling maple samara, students might ask questions about manipulating the object to improve its motion (2d, 2e, 8a, 8b);
d) formulating hypotheses about the cause-and-effect relationships involved in a particular area of investigation; for example, changing the pitch on the propeller of the model airplane will cause its flight to follow a predictable pattern (2d, 2e, 5d, 8b);
e) experimenting by testing hypotheses, making observations, and carefully manipulating conditions (controlling variables), for example, observing the effect of changing the mass of a flying or falling object (2d, 2e, 3, 5d, 8b);
f) constructing theoretical models and distinguishing between such a model and the reality it represents (2e, 8b).

Knowledge. Students will be expected to:

a) state the meaning of the following terms: observation, inference, prediction, measurement, investigation, interpretation, hypothesis, scientific model, variable, control;
b) identify career opportunities in science and describe the general requirements for these careers (2f, 8e);
c) list and discuss two or three strengths and limitations of scientific investigation (2a, 2c, 5b, 8a, 8b);

d) distinguish between science and the application of science, that is, between science and technology (2a, 4a);
e) describe a Canadian scientist's contribution to a particular area of science and discuss the scientist's work in relation to the use of problem-solving skills (2f, 8d).

2. Student Activities

Students are to:

*a) with the aid of a questionnaire and subsequent discussion, identify and record their initial opinions on, attitudes towards, and basic conceptions of the nature of science (This activity is to be repeated at the end of the unit.) (8a);
*b) use all their senses except taste to observe a common object, extend their ability to observe by taking quantitative measurements, and use the observations to make inferences (5a, 6, 8b);
c) do experiments that show the possible unreliability of the senses, for example, holding a hand in ice water for several minutes and then dipping it into water at room temperature, examining optical illusions, or identifying pitch (5a);
*d) design and conduct simple experiments to test their hypotheses about a particular area of investigation (5b-5d, 8b, 8c, 8f);
*e) construct a scientific model, make predictions based on the model, and test their predictions (5b-5d, 8b);
*f) gather information and prepare a brief report on a Canadian scientist, showing how his/her work illustrates the nature of science, or prepare a brief report on how science or science education can influence career opportunities (8c-8e).

3. Applications

Applications of scientific process skills will emerge from student activities and class discussions. Students can provide examples of instances in which they apply processes such as the following: observing and questioning, inferring and hypothesizing, collecting and interpreting data, experimenting by controlling variables, formulating models or theories and testing them, and reaching a conclusion or arriving at an explanation.

The applications of process skills might be discussed in terms of the following:

a) student activity 2c
b) some problem that a scientist has faced
c) a local science-related issue mentioned in the news
d) the most successful way to get rid of a cold
e) the best way for a family to take a journey to the Arctic or to the tropics

4. Societal Implications

a) Scientific discoveries and principles influence technology, which in turn develops a variety of products that affect our daily lives.
b) The research and findings of scientists directly affect the jobs at which people work and the goods they buy.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) observations, inferences, and ability to distinguish between the two;
b) formulation of questions and hypotheses during a scientific investigation;
c) isolation and control of variables in a simple experiment;
d) diagnosis of a problem.

Note: Since this unit emphasizes the processes of science, it is especially appropriate to use various methods for evaluating student achievement. A variety of evaluative techniques is discussed in section 14 of Part 1 of this guideline.

6. Safety Considerations

Students should not taste any substance unless it is known to be harmless. Other safety considerations will depend on the particular activities and experiments chosen for investigation.

7. Possible Extensions

Some students might:

a) complete a short science project related to a particular problem that might emerge from the activities carried out by the entire class;
b) conduct a "physics Olympics" competition involving the construction of simple models (e.g., bridges, towers, mobiles) to determine who can construct the longest, highest, largest, or strongest structure.

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*See the subsection entitled "Student Activities" on page 6.

8. Some Teaching Suggestions

a) Before teaching this unit, the teacher should have students answer a questionnaire in which they are asked to agree or disagree with statements about the nature of science and the way scientists conduct investigations. The questionnaire should be repeated at the end of the unit, and students should compare their responses to the two questionnaires and discuss the differences.

b) The information gathered at the beginning of the unit about student understanding and awareness of science should be used to determine the kind of assistance that students will require in completing their activities. This may be the most formal exposure to scientific processes and laboratory work that students will have had to date. Activities should be teacher-directed until students become comfortable with these new skills.

c) Particular attention must be paid to guiding students as they formulate questions and hypotheses. Through a discussion of the questions "How can we make sure this is a fair test?", "How can we verify our results?", and "What other hypotheses can we make?", students can be led to an understanding of the experimental approach to problem solving.

d) The scientists and technologists studied might include one or more of the following:

   - Wallace Rupert Turnbull, who developed the variable-pitch propeller
   - Maud Lenora Menton, a pioneer in research related to enzymes, blood sugar, and kidney functions
   - Casey Baldwin, the first Canadian to fly a plane, and his work with hydrofoils
   - Carl Agar and his work on helicopters
   - Armand Bombardier and his invention of the snowmobile

   The study of these or other individuals can include an examination of important dates in their lives, their early childhood experiences, their education, their contributions to science (e.g., research, experiments) and the societal implications of these, and the influence of their work on technological advances. The study could conclude with students' giving their own personal comments, impressions, or conclusions.

e) In their reports on ways in which science or science education can influence career opportunities, students might consider the following occupations: pharmacist, veterinarian, dietitian, forester, and physical chemist. These can be examined in terms of such aspects as the following: job description, working conditions, educational preparation, verbal aptitude required, numeric aptitude required, science requirements, new discoveries and their effect on employment, projected demand for workers in the field, wage range.

f) Students may be introduced to the following as a series of steps to be followed in scientific problem solving:

   - identifying a problem
   - defining the problem
   - establishing hypotheses
   - testing hypotheses (experimenting)
   - drawing conclusions
   - applying the findings
   - evaluating the conclusions

   Other creative ways of approaching the process of problem solving might also be considered.

Core Unit 2

Characteristics and Classification of Living Things

Time: 16 hours

We are surrounded by a wide variety of living organisms, which influence our lives in many ways. Plants and animals provide food and many of the raw materials necessary to civilization. This unit will help students to learn to recognize the characteristics of a variety of living things and to develop the important skills of observing and classifying. While examples of biological classification are used to develop the concept and skills of classification, the learning of this specific content is not to be considered as an objective of this unit.

This unit may be divided into topics such as the following:

- ▸ Classification as a skill
- ▸ Characteristics of living things
- ▸ Use of the microscope: an examination of plant and animal cells
- ▸ Characteristics: a comparison of plants and animals
- ▸ Classification of plants and animals: a simple overview
- ▸ Plants and animals in our lives

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation of the usefulness of classification as a tool in everyday life (2a, 2d, 3d, 4a, 4b);
b) an appreciation of the wide diversity of living things (2d-2g, 3d, 4c);
c) an appreciation of the usefulness of the microscope for studying small things (2g);
d) a caring attitude towards living things (2f).

Skills. Students will have the opportunity to develop skill in:

a) observing, describing, and comparing the characteristics of many different plants, animals, and other living things (2c-2g);
b) classifying living things informally into major groups according to observed characteristics (2d, 2e);
c) constructing simple biological keys based on their own observations and using them to identify the organisms (e.g., coniferous trees) that live in a particular area (2e);
d) recognizing the attributes that are used for constructing a classification scheme for living things (2a-2e);
e) adjusting the light and focus of a simple microscope to view living things (2g);
f) preparing dry-mount slides (2g);
g) describing and drawing the images seen through a simple microscope (2g);
h) making a wet-mount slide (2h);
i) recording information in charts, tables, and tree diagrams (2b);
j) handling plants and animals with care (2f).

Knowledge. Students will be expected to:

a) use the following terms both orally and in their writing: classification, cell, plant, animal, reproduction, metabolism, movement, irritability, biological key, vertebrate;
b) explain the arbitrary nature of a classification system (2a, 5c, 8a, 8d);
c) describe the external characteristics of a particular organism (2c, 2d, 5a, 5b, 8a, 8b);
d) list the general characteristics of all living things (2c);
e) compare general characteristics of plants and animals (2b-2d);
f) describe characteristics of a plant cell and an animal cell as observed through a microscope (2g);
g) compare the characteristics of selected vertebrates, invertebrates, or plants (2d, 8a, 8b).

2. Student Activities

Students are to:

a) classify a number of common objects into several groups according to easily observed characteristics (5a);
*b) construct charts or graphs to record comparative data about representative plants or animals. These can be constructed in conjunction with a number of student activities in this unit (5a-5d);
c) conduct investigations of plants and animals to find some evidence of the characteristics of living things (6, 8a, 8b);
*d) observe and classify plants and animals from a local environment (5c, 5d, 6, 8a-8d);
*e) make and use biological keys to identify living organisms near the school (5d, 6, 8a-8d);
f) take responsibility for the plants and animals in the classroom (6, 8c);
*g) observe plant and animal cells under a microscope (5e, 6a, 6c, 8e);
*h) make a wet-mount slide.

3. Applications

a) Living things are the source of all our food and of many materials such as leather, wood, and wool.
b) We use living things for many recreational activities.
c) Living things are an important aesthetic component of our environment.
d) Classification is an important skill that can be applied to many aspects of study and work. Classification systems are necessary for the scientific study of living things.

4. Societal Implications

a) Classification helps us to organize our information and understanding of living things and to communicate with each other about living things. It is used extensively in our society (e.g., in the classified advertisements in newspapers, in the yellow pages of the telephone book).
b) Our growing understanding of the characteristics of living things helps us to establish values and make decisions about our relationships with other living things (e.g., conservation, preservation, management). In doing so, we must answer such questions as "Do we consider other living things as a resource for humans or vital components of a global ecosystem?"
c) Many living things (e.g., trees, grains, fish, cattle) are the bases of large industries that provide thousands of jobs for Canadians and contribute to the wealth of Canada and Ontario.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) direct qualitative and quantitative observations of plants and animals;
b) records of their observations and laboratory activities;
c) designs of a simple classification scheme;
d) identification of organisms by means of a simple biological key;
e) ability to use and take care of the microscope.

6. Safety Considerations

a) Students must be aware that some plants and animals may cause allergic reactions.
b) Students are to be reminded of precautions in handling animals that may scratch or bite.
c) Proper hygienic procedures must be followed in the handling of any living thing.

7. Possible Extensions

Some students might:

a) examine under the microscope the organisms found in a particular place, such as a pond;
b) collect samples of plants (in a manner that will not disrupt the natural environment) and devise a suitable classification system (e.g., one based on leaves and seeds);
c) develop a biological key to help them to identify the plants and animals found in a particular area;
d) use commercially produced biological keys to identify special groups of plants or animals;
e) complete a library study of a particular species of plant or animal;
f) construct a formal biological classification system for a particular group of organisms.

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*See the subsection entitled "Student Activities" on page 6.

8. Some Teaching Suggestions

a) The emphasis in this unit should be on the direct observation and classification of living organisms. Plants and animals that are found in the neighbourhood of the school or at a local field-study area, or those that can easily be kept in the classroom, should be the basis for this work.

b) Common animals that can be studied in the classroom include fish, gerbils, hamsters, rats, guinea pigs, mice, meal worms, sow bugs, crayfish, and snails. Plants that germinate readily and grow easily in the classroom include beans, peas, radishes, lettuce, corn, and alfalfa.

c) Teachers should insist that students treat animals and plants properly and take responsibility for them. Specimens collected for brief observation should be returned to their natural environment. Ontario animal-care legislation must be adhered to in the classroom. This legislation requires all school boards to have a local animal-care committee. Reference should be made to the following sections in Part 1 of the guideline: "Animal Care in Science Courses" and "The Safe Use of Plants" (subsections 9.3 and 9.4) and "Some Poisonous Plants" (Appendix D).

d) The lack of emphasis on formal biological classification in this unit means that it is quite reasonable for Grade 7 students to talk in general terms about plants and animals. Teachers should be aware that biologists formally use a five-kingdom classification system: monera, protists, fungi, plants, and animals.

e) A microscope with a magnification of 100 is sufficient for this unit.

f) The basic skills and concepts taught in this unit may be enhanced by teaching optional unit 2, "Plants in Our Lives", or an appropriate locally designed unit (e.g., one on microscopy).

Core Unit 3

Properties of Matter

Time: 16 hours

A study of the properties of matter will help students to understand the physical world. They will develop skill in comparing, identifying, and classifying objects according to their physical, chemical, and biological properties. Students will also be better able to identify and understand the changes of state that occur around them. In this unit the fact that the use of a substance is determined by its various properties is stressed. A knowledge of the properties of matter will lead to a better understanding of the uses and possible hazards of the materials found in our daily lives.

This unit may be divided into topics such as the following:

- Description of an object
- Qualitative and quantitative properties
- Biological, chemical, and physical properties
- Solids, liquids, and gases
- Changes of state
- Definition of matter
- Comparative testing

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation of the importance of recognizing the properties of a substance and the significance of investigating such properties (2a-2d, 2f, 3a, 3e, 4a, 4b, 8a);
b) a willingness to defer their judgement about the uses of a particular material until sufficient observational data have been collected (2f, 3c, 3e, 8d).

Skills. Students will have the opportunity to develop skill in:

a) making observations by using their senses and drawing inferences from their observations (2a, 2e, 2f);
b) measuring several properties of an object, such as its length, mass, and volume (2d);
c) classifying the properties of an object as qualitative or quantitative (2a);
d) comparing several substances with respect to given properties, such as solubility, hardness, and conductivity (2b, 2c, 2f);
e) classifying substances as solids, liquids, or gases (2e);
f) devising methods of determining and controlling variables (2f);
g) making charts, graphs, and models related to the process of collecting and comparing data, for example, organizing information on a simple comparison chart and transferring it to a bar graph or pictograph (2a-2d);
h) recognizing and using simple laboratory equipment such as metric rulers, balances, graduated cylinders, and Celsius thermometers (2d-2f).

Knowledge. Students will be expected to:

a) choose correct SI units for use in measurement, for example, centimetres for the length and width of a desk, kilograms for the mass of a student, cubic centimetres or millilitres for the volume of a beaker of water (2d);
b) define *solid*, *liquid*, and *gas* on the basis of volume and shape;
c) name the six possible changes of state and indicate the heat change that occurs in each (2e);
d) define *matter* as anything that has mass and occupies space;
e) state that scientists' inferences and hypotheses are based on observations (2e, 2f);
f) distinguish between qualitative and quantitative properties (2a);
g) differentiate among biological, chemical, and physical properties (2c, 8c);
h) give reasons why it is important to be knowledgeable about properties of matter (2e, 2f, 3, 4, 8a, 8d).

2. Student Activities

Students are to:

*a) describe various objects according to observations made by the senses, classify their observations as qualitative or quantitative, and distinguish between observations and inferences (5a, 6a, 6b, 8a);
b) examine a number of different objects and organize them into categories, for example, magnetic and non-magnetic, living and non-living, and soluble and non-soluble (8a, 8b);
c) conduct investigations to differentiate among biological, chemical, and physical properties (5b, 6, 8a-8c);
*d) extend their observations by using measuring instruments (e.g., rulers, graduated cylinders, simple balances) to assist them in describing various substances, and record the data;
e) conduct experiments to test hypotheses about changes of state (6c, 8b);
*f) design and conduct experiments to test some of the physical properties of various substances, for example, the absorbency of paper towels, the tensile strength of thread, the insulating properties of home-insulation products, or the solubility of drink powders (5c, 6c, 8a, 8b, 8d).

3. Applications

a) A knowledge of the melting and boiling points of various substances makes it possible to identify or separate the substances.
b) Antifreeze is used in car radiators because it has a much lower freezing point and a much higher boiling point than water.
c) The use of various substances in items in our homes relates directly to the properties of the substances; examples of such items include clothes, furniture, tools, foods, and medicines.
d) Synthetic substances are made with properties similar to natural substances and can be used as substitutes in many applications (e.g., rayon resembles silk, polyester resembles wool, plastic resembles wood and steel).
e) Forensic investigations depend, in many cases, on the fact that substances have characteristic properties.

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* See the subsection entitled "Student Activities" on page 6.

4. Societal Implications

a) Some substances (e.g., water, silicon, gold, petroleum, diamonds) are highly valued partly because their properties suit them to unique uses.
b) The need for substances with specific properties (e.g., wood, minerals, plastics) is the basis for industries that provide thousands of jobs and contribute greatly to the welfare of Canada and Ontario.
c) Some methods of acquiring the substances demanded by society may have a detrimental effect on the environment (e.g., clear cutting and strip mining).
d) Some people invest a great deal of time and money in seeking to acquire materials that are valued because of their unique properties.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) oral and written descriptions of the observations and inferences made in student activity 2a;
b) records of experiments and science notes;
c) laboratory work and the design and successful completion of an experiment, as in activity 2f.

6. Safety Considerations

a) Since some substances are harmful, no substance is to be tasted unless the teacher specifically instructs students to do so.
b) When smelling any substance, students should use the wafting technique.
c) Students should always use caution when heating substances. Their eyes should be protected when they are heating liquids.

7. Possible Extensions

Some students might:

a) investigate changes in volume and mass during a change of state;
b) calculate the mass of a given volume of air;
c) devise a method for calculating the volume of an irregular solid using displacement;
d) prepare carbon dioxide and investigate its properties;
e) using dyes, investigate the technique of separating components of colours (chromatography);
f) conduct a library search on non-matter, plasma, and antimatter and prepare a brief report.

8. Some Teaching Suggestions

a) The importance of the properties of a substance and the significance of the experimental method used to investigate such properties must be stressed throughout this unit.
b) Students should be required to submit a plan of their individual investigations ahead of time. The teacher should check the hypothesis, materials needed, and method and have the students make the revisions necessary for safety and success. Complete, accurate, and concise reports should be required.
c) Students should realize that there may not always be a clear distinction among various kinds of properties. As a rough rule, properties based on the existence of life are biological; properties based on reactions in which new substances are produced are chemical; other properties observed directly by any of the five senses are generally physical.
d) Students can be involved in deciding which properties are important for a particular use of a substance, how to compare these properties either quantitatively or qualitatively, and how to make sure that the comparison is done objectively.
e) A variety of methods of evaluation should be used on a regular basis.

Core Unit 4

Conservation of Energy

Time: 16 hours

Modern society places large demands on non-renewable sources of energy. In time, some of these sources will be depleted. It is essential that we use the energy from these sources wisely and develop alternative and renewable sources if we are to maintain our present standard of living. All students should appreciate this problem and begin to practise ways of living that exemplify the "conservation ethic".

This unit may be divided into topics such as the following:

- Energy and its various forms
- Sources of energy
- Uses of energy
- Conservation of energy
- Cost of energy

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation for the need to conserve energy and use it efficiently (2g, 3, 4b, 4f);
b) a willingness to practise conservation in their own lives (2g, 5d, 8d, 8e);
c) a concern for the environmental impact associated with particular energy sources (4d);
d) an appreciation for the teamwork necessary for effective energy conservation (2g, 4c, 4f, 8e);
e) open-mindedness in considering energy solutions for the future (4a, 4d, 4e).

Skills. Students will have the opportunity to develop skill in:

a) measuring temperatures in the school, home, and outdoors in degrees Celsius (2b-2d, 2f);
b) graphing temperature readings, for example, in bar graphs to compare temperatures in various locations (2b, 2d);
c) observing and recording information from hydro and gas meters (2a);
d) interpreting data obtained from reading meters (2a);
e) planning ways of conserving energy (2g);
f) predicting and testing the results of a conservation plan (2g);
g) designing and conducting comparative investigations, such as determining the insulating properties of various materials in a model home or comparing the effectiveness of various numbers of blades on a model windmill (2f);
h) interpreting the information on labels on electrical appliances and calculating roughly how much energy the appliances use over a period of time (2e);
i) using a variety of sources to gather information about present and possible future sources of energy.

Knowledge. Students will be expected to:

a) define *energy* as that which does or is capable of doing work;
b) list examples of at least five different energy forms (e.g., heat, light, sound, electrical, mechanical, magnetic, chemical);
c) list the various sources of energy – traditional and alternative, renewable and non-renewable;
d) name the forms of energy used in the home or school and match each with its appropriate source, for example, heat from oil or gas and light from electricity (8b);
e) list the amounts of energy from different sources that are used in the home or school over a period of one year (2e);
f) describe methods by which heat and light could be conserved in the home or school and estimate how much money could be saved (2e, 2g);
g) discuss how alternative or renewable sources of energy could be used in the home or school;

h) name the units of consumption of electricity (kilowatt hours), gas (cubic metres), and oil (litres) (8f);
i) describe advantages and disadvantages of different sources of electricity (e.g., hydro, coal, oil, wind, nuclear, solar).

2. Student Activities

Students are to:

*a) read hydro or gas meters, record the amount of energy used over a period of time, and calculate its cost (5c, 6a, 6b, 8b, 8d);
b) measure the temperature at various places in the school and suggest reasons for differences, for example, elevation in the room; relation to windows, doors, or heat sources; exposure to sunlight; colours of nearby materials (5b, 6b, 8a);
c) investigate the relationship between the outdoor temperature and the amount of fuel used to heat the school (5b, 6b, 8c);
d) investigate the relationship between the locations of various thermostats and different temperatures in the school (5b, 6a, 6b, 8a);
*e) discover the power rating of various electrical appliances in the home or school and calculate roughly how much energy each uses in a year (5b, 6c, 8e);
*f) devise and conduct an investigation, for example, to compare the insulating value of various materials (5b);
*g) study the use of electricity in the home or school and devise a plan for reducing the amount used or plan and conduct activities that will encourage a co-operative approach to energy conservation in the home or school, for example, advertising campaigns, posters, incentive programs, recycling drives, recommendations to parents or school administrators (5b-5d, 8a-8f).

3. Applications

a) Many buildings are being equipped with such devices as solar panels in order to reduce dependence on oil and natural gas.
b) Most large industries and school boards employ energy-conservation experts.
c) Houses are being insulated and renovated in various ways in order to reduce loss of heat and waste of energy.

4. Societal Implications

a) Energy conservation is necessary in all parts of society if the present standard of living is to be maintained.
b) New buildings should be designed to be energy-efficient.
c) Governments often support research into alternative and renewable sources of energy to help make them feasible.
d) The choice of energy sources must include a consideration of both short- and long-term environmental implications.
e) There is a need to consider the restructuring of electricity rates, because, at present, the more a consumer uses, the lower the rate becomes.
f) An effective national energy-conservation plan is dependent on each individual's practising energy conservation.
g) In our desire to construct energy-efficient homes, care must be taken so that they are not so airtight that oxygen levels become depleted.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) notes and records;
b) designs of a comparative investigation;
c) interpretations of readings from meters and thermometers;
d) energy-conservation plans for the school or the home.

Not more than 15 per cent of the term mark for this unit is to be allotted to the mathematical solution of energy and cost problems.

6. Safety Considerations

a) If permission is received to read the energy meters in the school, the custodial staff should be consulted regarding safety precautions.
b) A list of safety rules should be provided for students to follow when they are conducting activities outside of the classroom.
c) A list of safety procedures should be provided for students to use when examining appliances.

7. Possible Extensions

Some students might:

a) construct a solar panel and conduct experiments to discover its most efficient use;
b) design experiments to compare the heat released when equal masses of various kinds of wood are burned;
c) complete a detailed analysis of the utility bills from their homes over a period of time;
d) investigate the effect of wind on the temperature in the school or home;

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*See the subsection entitled "Student Activities" on page 6.

e) investigate the effect of the orientation of windows on the temperature in a room;
f) investigate the ability of different substances (e.g., sand, water, paper) to store heat;
g) record temperature readings, plot a line graph from the data, and interpret the results.

8. Some Teaching Suggestions

a) Much of this unit may be taught by dividing students into groups and having each group work on a particular investigation.
b) A class tour of the school can be conducted. Students should observe the school's sources of energy, the various meters, and the means used to transport energy through the building. The teacher should request the help of the school's custodial staff when planning this unit.
c) Information on the school's use of energy in previous years can be obtained from the administration offices of the school board.
d) Instead of concentrating on the school, the unit could concentrate on students' homes, a community centre, an arena, or another suitable building. However, when students are collecting energy information from the home, accommodation must be made for those students who may not be able to participate fully (e.g., those who live in an apartment).
e) All the teachers, students, and support staff of the school might be involved in an energy-conservation project.
f) Undue stress should not be placed on students because of mathematical work. They should understand that consumers buy cubic metres of gas, litres of oil and gasoline, and kilowatt hours of electricity. They should know, for example, that a kilowatt hour is the amount of energy consumed by a kilowatt (1000 W) appliance that is operated for one hour or a 500 W appliance that is operated for two hours. They should also estimate the approximate number of hours that an appliance might be used over a period of one year. *Note*: In some areas, electrical energy may be measured in megajoules. If so, it is not necessary to define the megajoule, other than to indicate that it is a quantity of electrical energy.
g) The computer can be a useful tool for recording data and constructing graphs and charts.

Optional Unit 1

Chemicals

Time: 16 hours

Although students encounter a wide variety of chemicals in their everyday lives, they very rarely associate the substances studied at school with those used at home. By investigating the properties and uses of common household chemicals, students can learn to understand and better appreciate how and why these chemicals are useful and how some of them may be potentially harmful.

This unit may be divided into topics such as the following:

- Physical and chemical properties
- Classifying chemicals by their properties
- Testing for an unknown chemical
- Acids and bases
- Indicators
- Metals and their properties
- Uses of metals

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation of the fact that science can help to explain the majority of common natural events, such as the effects of acid rain (3a, 3b, 4b, 8i);
b) an appreciation of the value of classifying chemicals in relation to chemical safety (2e, 3b, 3c, 6g, 8c);
c) care in handling common household substances (4a, 6g, 8c);
d) a willingness to apply scientific techniques to solving problems in everyday life (2d);
e) an appreciation of the importance of following instructions, observing carefully, recording data accurately and neatly, and reporting objectively in scientific investigations;
f) respect for the safety and work of other members of a group.

Skills. Students will have the opportunity to develop skill in:

a) observing the properties of substances in relation to their safe use and proper handling;
b) using laboratory equipment correctly and safely;
c) recording data in charts or tables and then interpreting such data to others (5b, 8d);
d) describing qualitative properties of chemicals;
e) comparing several substances with respect to a given property, for example, texture, particle size, colour, or pH (2a-2e, 5c);
f) analysing the results of their investigations, making generalizations, and classifying substances on the basis of those results (2a-2e);
g) devising methods for testing a substance in the laboratory and for controlling variables during the testing (2d, 5c);
h) identifying an unknown substance by comparing its characteristics to those of several known substances (2e).

Knowledge. Students will be expected to:

a) correctly use the following terms: property, function, inference, chemical property, physical property, variable, control, acid, base, metal, indicator;
b) differentiate between quantitative and qualitative properties;
c) explain how properties may be used to compare, identify, and classify substances (2a-2e);
d) classify substances as acidic or basic (2e, 2f);
e) state two or three properties of acids, bases, and metals (2e-2g);
f) distinguish between an acid and a base and indicate in simple terms the effect that either one has on the other (8h);
g) list the properties of an acid-base indicator (2e, 2f);
h) explain the relationship between the properties and uses of a substance (3, 8i).

2. Student Activities

Students are to:

*a) use the senses of feel, smell, and sight to observe and record the properties of five unidentified common white powders, such as sugar, salt, baking soda, starch, and plaster of Paris (5b, 8a-8d);
*b) extend the sense of sight by using a hand lens and, if available, a simple microscope (8e);
*c) investigate some additional physical and chemical properties of the five powders by heating them and by testing them with water, vinegar, and iodine solution (tincture) (8a-8d, 8f, 8g);
*d) attempt to identify a sample of a white powder (one of the original white powders or a mixture of two of them);
*e) perform acid-base indicator tests on a variety of substances, such as vinegar, ammonia, baking soda, cream of tartar, fruit juice, rainwater, and melted snow (5b, 8h);
f) make an acid-base indicator from red-cabbage juice and use this indicator to investigate the effect of adding an acid to a base or vice versa (8h);
g) perform experiments on a few common metals to discover some of their physical and chemical properties, for example, magnetism, ductility or flexibility (of wire), electrical conductivity, heat conductivity, colour, lustre, and susceptibility to corrosion (3c, 6f, 6g, 8i).

3. Applications

a) In baking, baking soda and baking powder are used to produce a gas.
b) Most drain cleaners are strong bases, which react with the animal and vegetable matter in the drain.
c) Copper is used for electrical wires because it is a good conductor and ductile; aluminum is used for pots and pans because it is light in mass and is a good conductor of heat.
d) Scientists in industry are constantly looking for new uses of various substances on the basis of their properties.
e) Many substances are highly valued because of their useful properties (e.g., the hardness of diamond makes it an excellent material for drilling bits).

4. Societal Implications

a) Many substances, not only powders, look alike, and yet some may be poisonous and others very beneficial. Therefore, great care must be taken in labelling them and in reading the labels.
b) Pollutants dissolved in rainwater and snow often produce an acid (acid rain) and present a hazard to our environment.
c) Large industries and hence many jobs are based on obtaining a specific material (e.g., copper), refining it, and using knowledge of its properties to find new uses for it.
d) Many products are effective because of the properties of a single active ingredient. These are often sold under different brand names, at different prices, and with a variety of advertising approaches.
e) In many cases, an ingredient (e.g., a preservative) is added to water, foods, or household products because of one of its particular properties. Other properties of the ingredient may have side effects, beneficial or otherwise, that should be taken into account (e.g., hand softeners in detergents).

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*See the subsection entitled "Student Activities" on page 6.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) practical laboratory organization and techniques;
b) laboratory records, including charts;
c) written or oral interpretations of investigations.

6. Safety Considerations

a) Students are to be warned that chemicals are often corrosive and poisonous and that they are to handle or test them only when specifically directed to do so. It is recommended that students not taste any substances in a laboratory situation.
b) Eye protection should be worn and loose hair and clothing tied back whenever any chemicals, especially acids and bases, are being handled or heated.
c) Each person in a group activity is responsible for the safety of others as well as for his/her own safety.
d) If thermometers are used to determine melting points, students must be warned that they are not to place the bulb of the thermometer near a flame. Alcohol thermometers are to be used rather than those with mercury.
e) Heating activities must be conducted on flat, level surfaces. A multipurpose fire extinguisher must be available in the classroom when open flames are used.
f) In tests for electrical conductivity, dry cells or batteries not exceeding 24 V should be used as a source of electricity. A 110 V (alternating current) source is not to be used.
g) Students should not experiment with highly corrosive substances such as drain cleaners.

7. Possible Extensions

Some students might:

a) extend the variety of indicators and of household acids and bases used;
b) investigate additional properties of metals (e.g., malleability);
c) discuss the relationship between property and function in the materials in a number of appliances that are composed of both metallic and non-metallic components.

8. Some Teaching Suggestions

a) Before beginning activities 2a-2c, the class should be divided into groups and each group asked to bring a container from home (e.g., a shoe box) for storing materials. Each group will need five paper cups and five stirring sticks as scoops. Each cup and scoop should be marked with a number or letter to correspond to the five powders. Students must not intermix the sticks, otherwise the results will be difficult to interpret.
b) When groups of students are investigating the powders, the duties within a group should be rotated to be sure that no one student always does the same task. Each student should experience all phases of the investigation.
c) If students have not had much experience in working with chemicals, the teacher should discuss the sharing, storage, and care of materials.
d) Wherever feasible, students should record their results in charts or tables.
e) After examining the powders with a hand lens, students might consider the following questions: "In what ways are the powders alike or different?"; "What are the shapes of the various crystals?"
f) After investigating the effect of water in activity 2c, students might consider the importance of the amount of water that is used and how the results are affected by changing the amount of water. Evaporation of the solvent might be considered, and small amounts of solutions of dissolved powders might be left to evaporate overnight.
g) Students can be asked the following: "If iodine or vinegar react with only one powder, can this reaction be used to identify that powder?" This leads to a discussion of "conclusive" tests and characteristic properties.
h) Students may be familiar with certain acids used at home, such as lemon juice or vinegar, which may be used to investigate the effect of acid on an indicator and to establish an operational definition of *acid*. Students should learn that all acids share some common properties and that all bases share some other common properties. Formal work on neutralization is not required in this course. It is appropriate, however, to refer to simple or common acid-base reactions. Students should realize that the strength of an acid can be reduced by adding a base, and vice versa (e.g., antacid).
i) Activity 2g should be related as much as possible to articles found in students' homes (e.g., aluminum foil, copper electrical wire, brass screws). Differences between metallic and non-metallic components in various articles (e.g., the pan and handle of a frying pan) can be discussed. Students can make a collage to show a variety of uses of one metal. Groups of students can choose different metals.

Optional Unit 2

Plants in Our Lives

Time: 16 hours

This unit is designed to survey the many and varied ways that plants affect us in our daily lives and to provide students with an opportunity to conduct simple experiments that lead to a better understanding of the nature of plants. If students have studied plants extensively in the Junior grades, this unit may not be appropriate, but if this is not the case, a specific study of plants can be a natural extension of core unit 2.

This unit may be divided into topics such as the following:

- ▸ Plants in the natural environment
- ▸ Plants as food for humans
- ▸ Medicine from plants
- ▸ Plants for beauty and enjoyment
- ▸ Products from the forests and fields
- ▸ Problem plants
- ▸ Adaptations for survival
- ▸ Conservation

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation for plants because of their value to other living things (3a, 3c, 4a);
b) an appreciation of the significance in their lives of agricultural and other plant-based industries (2c, 3a, 3d, 4c, 4d, 8b);
c) a caring attitude towards plants in the classroom and elsewhere (2e, 8b);
d) concern for the protection of plants, particularly rare and endangered species (3b, 4c, 8b);
e) an appreciation for the contribution of scientific research to the development of new and improved plants for food production (3a, 3b);
f) a concern for the protection and preservation of important plant habitats such as wetlands and forests (8b).

Skills. Students will have the opportunity to develop skill in:

a) observing and accurately describing the properties of some plants (2e);
b) recording observations and the results of experiments in notes, charts, graphs, and diagrams (2a, 2b, 2e-2h);
c) planning and carrying out experiments to determine the factors necessary for the germination or growth of plants (2a);
d) classifying plants by use (raw material or processed product), country of origin, and parts used (2b);
e) planting and growing seeds, making cuttings of a house plant, planting bulbs for winter bloom, or growing plants hydroponically under lights (2e);
f) caring for plants (2e).

Knowledge. Students will be expected to:

a) explain the value of plants in their environment as fixers of energy, producers of carbohydrates needed by animals, producers of oxygen, and habitats for wildlife;
b) explain the processing from raw material to finished product (e.g., a breakfast cereal) of one or two common processed plant foods (2b, 4a);
c) list at least three drugs used in medicine and the plants from which they are derived (2d, 3c);
d) list four ways in which plants improve and beautify our surroundings, for example, as house plants, in gardens, as landscaping in parks and preserves, by providing shade, by preventing erosion, by providing windbreaks, and as a subject matter in the arts (2f);
e) list five products (e.g., building materials, paper, firewood, oils, resins, acids, solvents) obtained from forest trees;

f) explain briefly how cotton, linen, and rayon are made from plants (3c);
g) explain why some plants are classified as weeds (2f, 2g);
h) name and describe one poisonous or allergenic plant (e.g., poison ivy, poison oak, philodendron, dieffenbachia);
i) draw up a chart of five to ten common plants and their adaptations for survival; for example, the basal leaves of the dandelion eliminate competition from grasses (2g).

2. Student Activities

Students are to:

*a) perform at least one experiment to determine the factors necessary for seed germination or plant growth, for example, temperature, light, growth medium, moisture, quality of seeds (5a, 8c);
*b) survey grocery-store shelves or advertisements for foods obtained from plants; classify them as raw or processed, domestic or imported, and according to the part of the plant used; and present the data in appropriate bar graphs (5c);
c) visit a farm, greenhouse, orchard, sawmill, or furniture factory and relate the industry and employment to reliance on specific plants (8b);
d) interview a doctor or pharmacist to find out about some of the drugs and medicines that come from plants (8b);
*e) grow and describe house plants with attractive flowers and foliage, *or* plant bulbs for winter bloom, *or* grow vegetables hydroponically (5c);
*f) discuss what makes a plant a weed and then examine the most successful schoolyard weeds and account for their success;
g) examine some plants that have developed unusual ways of surviving adverse conditions;
h) conduct an experiment to test a given hypothesis relating to a plant process, such as capillary action, transpiration, osmosis, or tropism (5a).

3. Applications

a) A knowledge of the growing habits of plants and of the conditions necessary for optimum growth enables farmers to maximize their yield in the production of food.
b) A knowledge of the characteristics and requirements of specific plants allows us to provide for the wise use and conservation of plants in urban and natural environments.
c) A study of plants has produced such valuable by-products as therapeutic drugs and rayon.
d) There are a great number and variety of useful products that have been derived from plants (e.g., paper, rope, rubber, cork, wood, textiles, oils, resins, solvents, perfumes, cosmetics, medicines, foods, beverages).

4. Societal Implications

a) At the present time food production in Canada is an energy-intensive industry that enables a few people to produce enough food for many. Therefore, most people are not directly involved in food production and do not realize the importance or the problems of the industry.
b) Intensive monoculture in agriculture has produced side effects such as erosion, the multiplication of selective breeds of pests, and a decrease in the number of species of plants and animals.
c) Plant resources such as trees are renewable only if we plan carefully for their use and replacement.
d) Canada has one of the greatest grain industries in the world.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) ability to plan and perform experiments and work in a group;
b) written records of experiments performed;
c) diagrams, charts, and graphs of information collected in the activities.

6. Safety Considerations

a) Students should be warned that some plants are poisonous; they should not taste or eat any plants or plant products unless instructed to do so.
b) The teacher should find out if any students have allergies and caution them to avoid plants that may be allergenic.

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*See the subsection entitled "Student Activities" on page 6.

7. Possible Extensions

Some students might:

a) conduct an experiment to demonstrate the need for light in the process of photosynthesis;
b) find out the origin of some spices and herbs;
c) prepare a terrarium and keep an unusual plant (e.g., a Venus fly-trap, mimosa);
d) make some dyes from natural materials and use them to dye some white cotton.

8. Some Teaching Suggestions

a) This unit will require the use of a variety of teaching methods, including readings, the viewing of visual materials, field trips, experiments by students, and demonstrations by the teacher or various students.
b) Students will be able to get first-hand impressions of important issues by interviewing people involved in various kinds of work related to plants and their derivatives (e.g., farmers, florists, forest rangers, horticulturalists, botanists, food producers and processors, food inspectors, environmentalists, government personnel).
c) In the case of many plants, germination tests are easier than growth tests, because they require less space and time.

Optional Unit 3

Science Project

Time: 16 hours

Conducting an independent scientific investigation provides students with an excellent opportunity to apply the skills and processes of science while studying issues of scientific concern. This unit suggests ways to arouse students' interest in science projects and to assist them in their completion.

The science project affords a significant opportunity for students to increase their skill in thinking, listening, speaking, reading, and writing, as outlined in the Ministry of Education resource document *Language Across the Curriculum* (1978).

This unit may be divided into topics such as the following:

- Choosing the topic
- Planning a project
- Devising an experiment
- Conducting an experiment
- Writing laboratory reports
- Sharing the project

1. Objectives

Attitudes. Students will be encouraged to develop:

a) curiosity about a particular aspect of their environment or some scientific issue (2a, 3a, 4a, 4b);
b) an appreciation of creativity as a part of the scientific process (2b, 2c, 8c);
c) respect for the significance of scientific investigations (4a);
d) self-confidence when approaching a project (8a-8c);
e) an appreciation of the fact that problem-solving methods can be applied in other school subjects (2c-2e);
f) a co-operative attitude when working with their peers.

Skills. Students will have the opportunity to develop skill in:

a) differentiating between topics and ideas when choosing a science project (2a, 8b);
b) following a logical procedure for studying natural phenomena (2b, 2c);
c) designing an experiment, collecting data, controlling variables, classifying, measuring, and drawing conclusions (2c);
d) making scientific investigations honestly and responsibly (2c, 2d);
e) conducting an investigation in a manner that will promote accident prevention in a classroom or laboratory where a variety of activities are carried on simultaneously (6a-6c);
f) organizing scientific data in tables and graphs so that they can be interpreted accurately (2d);
g) communicating information about their project in an interesting, informative manner (2e).

Knowledge. Students will be expected to:

a) describe a process of scientific problem solving that includes a provision for experimenting and the recording and reporting of information;
b) define and demonstrate an understanding of such scientific terms as the following: variable, control group, hypothesis, application.

2. Student Activities

Students are to:

*a) use science texts, reference books, encyclopedias, suitable magazines, or newspapers in developing a topic for a science project that they can investigate in a scientific manner (5a, 8a, 8b);
b) study sample projects to evaluate their strengths and weaknesses and consider how they could be improved and corrected;
*c) conduct an investigation and gather data for their chosen project (5b, 8c, 8d);
*d) write a report that includes the statement of a problem, a hypothesis, a method of inquiry, observations, and conclusions (5c, 8h);
*e) devise suitable methods of communicating their information and share it with one another, for example, by means of graphs, charts, tables, pictures, and audio and video presentations (5d).

3. Applications

Students should relate their projects to one or more applications in the real world, such as their homes, the consumer market, industry, medicine, health, travel, athletics, and the arts (8b, 8g).

4. Societal Implications

a) Students who develop a science project should gain a better understanding of how scientists gather the information on which they base their conclusions. This knowledge should make students more critical and discriminating citizens in our highly technical world.
b) Students' work on a simple science project may be the beginning of a new discovery, invention, career, or interest in science.

5. Evaluation of Student Achievement

The evaluation of science projects should be based on the ongoing development of the project as well as the presentation of the final product. The following components should be considered:

a) the choosing of a topic for investigation and the planning of the project;
b) the devising and conducting of the investigation;
c) the writing of the project report;
d) the presentation of the project.

6. Safety Considerations

a) The student plan for the project should include some provision for safety. In approving the plan, the teacher should ensure that specific safety concerns are addressed adequately.
b) The importance of taking sensible precautions when handling materials that may be poisonous, corrosive, or dangerous in any other way should be impressed on students.

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*See the subsection entitled "Student Activities" on page 6.

c) Teachers should be familiar with the Ontario Animals for Research Act and should inform their students of the relevant regulations. Vertebrate animals are not to be used in experiments or demonstrations. See Part 1 of this curriculum guideline (particularly section 9.3).

7. Possible Extensions

Some students might:

a) display their work to parents and other students in a local science fair;
b) make arrangements to present their projects to students from other schools or to adults at an open house.

8. Some Teaching Suggestions

a) Completion of core unit 1 and at least one or two other core units should give students enough experience with scientific problem solving that they can work independently on this unit, but they will still require considerable guidance, particularly in the early stages.
b) Students should be encouraged to choose simple topics that relate to their immediate environment or a current scientific issue. Scientific phenomena relating to hobbies, crafts, sports, homes, school, and local issues are more familiar and meaningful than obscure studies that require the gathering of extensive background information. Students may require considerable guidance in moving from a general area of interest to a specific question for investigation (e.g., from the general topic of heat to a specific investigation such as "Which materials are the best conductors?" or "What is the best location for a heater in a room?").
c) Students may need individual advice and assistance from the teacher in organizing the investigation of their topics. The teacher can help by making suggestions for the design of the experiment, for an alternative experiment, or for the addition of a survey, or simply by praising the good points in a student's project.
d) Whenever possible, time should be provided during and after school for interested students to work on their project in the classroom under a teacher's supervision.
e) If the school is holding a science fair, arrangements will need to be made well in advance for space, judges, tables, invitations, press releases, signs, decorations, and so on. Participation in science fairs should be voluntary.
f) Before the fair, all participating students should present their projects and practise their oral presentations. This can be done in class or in individual interviews with the teacher. This will help prepare students for being interviewed by the judge at the science fair.
g) The science project affords students an opportunity for individual learning about a topic of interest to them. Students' experiments often provide them with information about consumer products that is not available elsewhere.
h) Considerable information about science projects and science fairs is available from the Youth Science Foundation, 151 Slater Street, Ottawa, Ontario K1P 5H3. The foundation lists five categories, called "levels", for science projects, and they are widely accepted in Canadian schools. A modified description of the levels follows:

- A level 1 project consists of a diagram, copy, illustration, table, or other display of scientific information already available in printed or non-printed material. Such a display should include some written comments from the presenter(s).
- A level 2 project consists of a chart, illustration, collection, specimen, or outline based on a first-hand investigation. Some general comments should be included.
- A level 3 project consists of a working model based on scientific principles or a unique demonstration of a scientific principle. The scientific principle(s) should be identified, and a brief report on the model or demonstration should be included.
- A level 4 project consists of an experiment designed by the student(s) that attempts to answer a question or hypothesis where one or two of the variables have been controlled. It should be accompanied by a report.
- A level 5 project consists of an experiment designed by the student(s) that attempts to answer a question for which all the important competing variables have been considered.

Students in Grades 7 and above should be encouraged to work on a project at levels 3, 4, or 5. However, the teacher may, at his/her discretion, modify such levels or assign lower levels to suit student needs and abilities.

Optional Unit 4

Locally Designed Unit

Time: 16 hours

This unit is to be designed at the local level as desired. It can be used to introduce a new area or topic of science not described in this guideline or to incorporate additional objectives that will expand a part or parts of the course already covered. The following are examples of new areas or topics that might be considered:

- Agriculture
- Astronomy
- Careers in science
- Forestry resources
- Life cycles
- Rocks and minerals
- Space science
- Water
- Weather

This unit may provide an excellent opportunity for students to engage in independent study on a topic in science that is of particular interest and that is approved, monitored, and evaluated by the teacher. Students may work individually or in small groups. Care should be taken not to allow the work to overlap with subject matter in other science courses that the students are likely to take. The unit could be started after students have had some experiences in the laboratory and are well aware of accident prevention. If several short topics are considered, they may be fitted into the course schedule from time to time throughout the semester or year.

It is expected that the local design of this unit will incorporate components similar to those adopted in the core units, namely, objectives, student activities, applications, and societal implications. A description of the unit is to be included with the school's course outline and kept on file so that it is available to interested students and parents.

Science, Grade 8

Core Units

Solutions
Investigating Living Things:
A Process Unit
Force, Work, and Energy
Soil and Plant Ecology

(64 hours)

Optional Units

Heat and Temperature
Adaptations
Science Project
Locally Designed Unit

(16 hours)

Core Unit 1

Solutions

Time: 16 hours

Students seldom realize that they use solutions at home, in school, and during their leisure time. Solutions also play an important part in the functions of the human body. Students can achieve an understanding of some of the characteristics and uses of solutions as they develop and practise some of the skills and processes of science.

This unit may be divided into topics such as the following:

- Characteristics of solutions and mechanical mixtures
- Rate of dissolving
- Concentration
- Saturated and unsaturated solutions
- Household uses of some solvents other than water
- Water as an important solvent

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a respect for the possible hazards involved in manipulating a variety of solids, liquids, and gases (2b, 2c, 4c, 6);
b) an appreciation of the importance of water as a solvent (2g, 4a, 4b, 5a, 8a);
c) a commitment to the preservation of water resources (2g, 4d, 8a).

Skills. Students will have the opportunity to develop skill in:

a) inferring whether or not a liquid such as tap water is pure and then checking the inference (2f);
b) observing what happens to solutes when they dissolve in solvents (2e, 8d);
c) measuring solutes, solvents, and mass concentration (mass of solvent per volume of solution) using volumetric apparatus, balances, and the appropriate SI units (2d, 5b, 8e);
d) proposing a hypothesis, for example, that increasing the temperature of a particular solvent will increase its ability to dissolve a particular solute (2b, 2e, 8b);
e) choosing and using appropriate methods of recording and reporting observations, for example, charts, graphs, written reports, and oral presentations (5a);
f) classifying mixtures as mechanical mixtures or solutions (2a);
g) filtering solutions (2e, 8d).

Knowledge. Students will be expected to:

a) describe the difference between a mechanical mixture and a solution (2a);
b) define or correctly use the following terms: mixture, mechanical mixture, solution, solute, solvent, mass concentration, dissolve, soluble, insoluble, saturated, unsaturated, dilute, concentrated, mixture, filter, potable, filtrate, residue;
c) list examples of solutions in which a solid, a liquid, or a gas is dissolved in water (2a, 2f, 3b, 4a, 4b);
d) describe or explain at least two important examples of the use of water as a solvent (2g, 4a, 4b);
e) describe the influence of temperature on the solubility of a solute in a solvent (2b, 8b);
f) identify solvents other than water that are used in the home and indicate some corresponding solutes (2c, 3a, 8c);
g) state factors that affect the rate of dissolving, such as temperature and type of solute or solvent (2b, 8b).

2. Student Activities

Students are to:

a) mix small quantities of several substances (e.g., orange-juice concentrate, tea, sugar, bluestone, calcium carbonate, alum, Rochelle salt) in water and note what happens, use a chart to report their observations, and discuss their observations to develop the concepts of solution and mechanical mixture;
b) compare the rate at which a solute dissolves (i) when stirred and not stirred, (ii) in cold water and hot water, (iii) when finely divided and in large pieces, and (iv) in water and in alcohol (6c, 6d);
c) cleanse different stains from fabrics by using liquids other than water and list the best solvent for each stain (6a-6d, 8c);
*d) prepare a saturated and an unsaturated solution of a solute in water and compare the two solutions as to their respective colour and the mass of solute dissolved per given volume of solvent;

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*See the subsection entitled "Student Activities" on page 6.

*e) (i) observe a coloured solution through a magnifying glass before and after filtering; (ii) list their observations and propose an operational definition for *solution*; (iii) hypothesize as to why the dissolved solute is invisible (8b);

*f) slowly heat and completely evaporate a small quantity of a solution, distilled water, and tap water (6d);

g) write a report on the subject of water, including comments on the properties that make water a useful and convenient solvent; its uses in the home, industry, and the environment; water pollution; and the use of energy to supply purified drinking water.

3. Applications

a) Solvents are used in dry cleaning to remove stains from clothing.

b) Carbon dioxide is dissolved in soft drinks to make them fizzy.

c) Air is a solution of gases and consists mostly of nitrogen and oxygen. These two gases are often separated for use in hospitals and industry.

4. Societal Implications

a) Because water is a plentiful solvent, it is used in large quantities to dispose of used solutes, especially in industry. This practice, although convenient and effective, often pollutes the sources of our drinking water.

b) Ground water and surface water usually contain a variety of materials in solution. Such solutions are essential for plant growth, which, in turn, helps to sustain animal and human life.

c) The hazardous nature of many solvents (e.g., benzene, carbon tetrachloride) dictates that their use be regulated and that strict safety guidelines be followed in laboratories and industry.

d) Canada possesses a large proportion of the world's freshwater reserves. It is our duty to keep those reserves free from harmful pollutants.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) records or reports of investigations or experiments;

b) measurements of volume and mass and quantitative statements of solubility.

6. Safety Considerations

a) Students should be warned that some solutions encountered in their environment are poisonous, flammable, explosive, or corrosive.

b) The teacher should advise students to keep all liquids and solids away from their mouths and wash their hands after handling chemicals.

c) Volatile liquids like alcohol are to be used in small quantities only.

d) Alcohol or other flammable liquids are not to be used near open flames.

7. Possible Extensions

Some students might:

a) identify examples of solutions in each of the solid, liquid, and gaseous states and possibly name the solutes and solvents;

b) measure equal volumes of water and alcohol, predict what their combined volume will be, and mix them and measure the total volume. They should then repeat this procedure for other liquids;

c) discuss conservation of volume and mass and propose a hypothesis to explain the results observed in the preceding activity;

d) prepare a supersaturated solution;

e) grow crystals;

f) obtain information on stain removal and make a report to the class;

g) check samples of rain or snow for acidity and discuss the findings, suggesting possible sources of any solutes that may be indicated.

8. Some Teaching Suggestions

a) The importance of water should be stressed, and the need to develop a serious commitment to preserve our water resources impressed on students.

b) Students should realize that a hypothesis must be tested many times before a generalization can be made. For example, increasing the temperature will increase solubility in many cases, but not in all; the fact that air is less soluble in hot water than in cold can be demonstrated in the classroom.

c) Pieces of fabric can be stained with grass, paint, grease, nail polish, wine, and gravy. Liquids other than water that can be used for removing stains are varsol, rubbing alcohol, baby oil, and vegetable oil.

d) Students may need instruction in the folding of filter paper.

e) For a definition of "mass concentration", see note 36 to table 1 of Appendix B in Part 1 of the guideline.

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*See the subsection entitled "Student Activities" on page 6.

Core Unit 2

Investigating Living Things: A Process Unit

Time: 16 hours

This unit is in many ways similar to core unit 1, "The Nature of Science", in Grade 7, in that it emphasizes the processes of scientific problem solving. The Grade 7 unit examined the processes of science, presenting them as important components of the scientific method. This unit provides opportunities for students to use these processes in the context of problem solving. The examples used in the Grade 7 unit were related to physical science; in this unit, similar approaches are applied to life-science investigations.

This unit may be divided into topics such as the following:

- Basic scientific processes
- Control of variables
- Investigations involving plants or animals
- The work of a Canadian scientist

1. Objectives

Attitudes. Students will be encouraged to develop:

a) confidence in using scientific methods to solve problems (2a-2c, 3a, 4a);
b) open-mindedness towards new investigations, even though the procedures may be unfamiliar or the outcomes uncertain (2a-2c, 4a);
c) a willingness to accept a new idea if it proves more valid than a previous idea (3a, 4a, 4b);
d) a spirit of co-operation in group work (2a-2c);
e) a commitment to using laboratory equipment safely and correctly (6a, 6b);
f) a respect for living things (2b, 2c, 4c);
g) an appreciation for the achievements of scientists (2d, 8d).

Skills. Students will have the opportunity to develop skill in:

a) observing living things (2a, 2c);
b) making inferences and predictions based on observations (2b, 2c, 3a, 4a);
c) measuring, using suitable instruments and the appropriate SI units (2b, 2c);
d) using space-time relationships to describe events (2b, 2c);
e) planning and conducting investigations (2a-2c);
f) controlling variables (2a, 2c);
g) formulating and testing hypotheses, collecting data, and deciding which data support the hypotheses (2a-2c);
h) analysing the results of an investigation, drawing conclusions, and discussing the outcomes (2b, 2c);
i) using the appropriate laboratory equipment effectively and safely (2a-2c);
j) using appropriate forms (e.g., charts, graphs) to record and present data (2b, 2c).

Knowledge. Students will be expected to:

a) use the following terms: hypothesis, inference, control, variable, generalization, scientific problem, investigation, conclusion;
b) explain why observations are the basis of scientific knowledge (2b, 2c, 4a);
c) explain how scientific knowledge may be modified as a result of new observations (4a);
d) describe the contribution of a Canadian scientist (2d);
e) describe the effect of variables such as light, temperature, or water on the growth or behaviour of a selected plant or animal (2a-2c, 4a, 8c).

2. Student Activities

Students are to:

*a) do investigations involving at least two different independent variables to determine either (i) the effect of factors such as light, temperature, soil, or water on the germination rate of a given seed, or (ii) the effect of factors such as light, temperature, moisture, or colour on the behaviour of an invertebrate, such as a sow bug or meal worm (5a, 5c, 6a, 8c);
*b) measure size, mass, and temperature where appropriate in activity 2a; propose a hypothesis for each trial and test it against the findings; analyse the findings and compare them with those of other students; and then make and discuss some generalizations (3a, 5a-5c, 8a, 8c);
*c) gather and classify data on either (i) the mass, height, and age of students in the class or (ii) the reaction time of students to at least two types of stimuli (e.g., auditory, visual, tactile); report

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*See the subsection entitled "Student Activities" on page 6.

their findings by means of graphs or charts; and discuss any conclusions or generalizations that may be made (5a-5c, 8a-8c, 8f);

d) find information on the work of a Canadian life scientist, visit a biological research centre, or interview a biologist (8a, 8d-8f).

3. Applications

a) Some problems in life may be solved by collecting data and drawing conclusions from the data as is done in formal scientific investigations (8g).

b) Scientific investigations often lead to the formulation of scientific principles or generalizations, which in turn result in many practical applications that affect society (8h).

4. Societal Implications

a) The ability to examine a hypothesis in the light of collected data can help non-scientists draw conclusions on such issues as the effect of smoking, the safety of nuclear-power plants, and the causes of acid rain.

b) Politicians and government officials who make decisions on scientific issues should have a good understanding of the nature of science.

c) Scientific investigations involving living matter give rise to concern for the welfare of other things. An example of such concern is reflected in animal-care legislation.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) investigations in which some variables are controlled;
b) development and interpretation of charts or graphs;
c) contribution to a group activity and oral communication in class discussions.

6. Safety Considerations

a) The activities selected by students, where they have a choice, should be approved by the teacher, particularly in regard to safety.

b) Safety procedures that relate to the particular activities chosen for study should be reviewed and stressed.

c) Student allergies should be considered when plants or animals are brought into the classroom.

7. Possible Extensions

Some students might undertake an extended science project based on a life-science topic in addition to the mandatory student activities in this unit.

8. Some Teaching Suggestions

a) In this unit the primary emphasis should be placed on scientific processes as applied to the investigation of living things. The major focus is not intended to be the learning of substantive scientific content, but, rather, familiarity with the scientific method.

b) It may be necessary to review or teach graphing.

c) Each variable in the controlled investigations is to be changed in turn while the others are held constant. Several trials should be made for each variable; for example, when temperature is the independent variable, at least three different temperatures should be used.

d) Students should choose a Canadian scientist for their report (e.g., F. Banting, C. Best, W. Penfield, H. Hogg, C.E. Saunders, N. Ford-Walker, L. Siminovitch). The work of a scientist in the community may also be appropriate for a report. The discussion should concentrate on a problem presented to the scientist or a hypothesis that he/she has proposed, the scientific processes used by the scientist, present-day applications of the results of the scientist's investigations, the scientist's career, and interesting personal information.

e) A scientist can be invited to the school to speak to students, or a field trip can be taken to a place where scientific research is carried out.

f) Any experimenting or data gathering involving humans should be done with regard for the feelings of individual students. This is particularly important for students in Grade 8, since they are at a developmental stage in which they are very sensitive about their physical growth and appearance.

g) In regard to application 3a, which describes what is often called the "scientific method", students can debate its applicability to non-science areas such as finding a job, choosing a leisure activity, purchasing an expensive commodity, or deciding what electives to take in high school.

h) In regard to application 3b, which describes what is sometimes called the "science-technology-society connection", students can give examples to illustrate this relationship (e.g., scientific principle: pressure is distributed throughout a fluid system; technological application: sphygmomanometers are used to measure blood pressure; societal implication: personal blood-pressure variations are of interest and concern to humans).

Core Unit 3

Force, Work, and Energy

Time: 16 hours

Force, work, and energy affect our daily lives all the time. A study of these fundamental scientific phenomena will help students to understand many interrelationships in the environment and will provide them with a basis for informed decision making about the effects of technology on their lives.

Some mathematical problem solving is included in this unit. Problems should be based on activities in which students make measurements and then solve straightforward and meaningful problems.

This unit may be divided into topics such as the following:

- Force and its measurement
- Gravity and its relationship to mass
- Work and energy and the measurement of work
- Friction
- Machines: input, output, their impact on our lives
- Energy resources

1. Objectives

Attitudes. Students will be encouraged to develop:

a) objectivity in evaluating the effects of machines on society (3a, 3c, 4a-4e);
b) an appreciation of the relationship among science, technology, and society in regard to machines and the energy required to operate them (3a, 4a-4d).

Skills. Students will have the opportunity to develop skill in:

a) estimating and measuring forces, using non-standard and standard SI units (2b-2g, 8a, 8b);
b) repeating measurements to establish their reliability (2d-2g);
c) inferring various kinds of forces on the basis of their own observations (2a);
d) classifying forces into pushes and pulls – sometimes through student activities (2a-2c);
e) using tables and graphs to record and present data about forces and mechanical work (2c-2g);
f) calibrating a force meter (2b);
g) controlling variables in an investigation of friction (2g);
h) formulating hypotheses about forces (2g).

Knowledge. Students will be expected to:

a) identify different types of forces (2a, 8b);
b) describe a force meter as a product of applied science and explain its limitations (2b, 2c, 8e);
c) explain the importance of using standard units of measurement (2c, 2e, 8d);
d) define *force* as a push or pull and explain that it is measured with a newton spring scale (2c, 8d);
e) realize that the force of gravity acting on a 1 kg mass is approximately 10 N (2c);
f) explain that if there is a change in the motion or shape of an object, there must be a force working on the object and that when a force moves an object through a distance, work is done (2e, 8f);
g) interpret graphs that show the relationship between the stretch of a spring or elastic band and the force applied to it (2d);
h) using the formula $W = Fd$ and direct measurement, compute (in joules) the work done in a number of actual situations (2e, 8f);
i) recognize that a machine is simply a device that converts one force (or form of energy) to another, and identify some advantages and disadvantages of common machines (2h, 3a, 4a-4e);
j) explain why a ramp reduces the effort needed to raise a load and why the work done is not reduced; explain why the ramp is called a machine (2f);
k) explain the differences among starting, sliding, and rolling friction (2g);

l) state some advantages of increasing and decreasing friction and indicate ways of achieving such changes (2g, 3b);
m) define or correctly use the following terms: force, work, energy, newton, joule (8d, 8f).

2. Student Activities

Students are to:

*a) observe the effects of pushes and pulls on a variety of objects and infer the presence of different kinds of forces (e.g., magnetic, electric, gravitational) in a variety of situations, such as a rider and bicycle going down a hill (8b);
b) calibrate a simple force meter in arbitrary units and use the meter to measure the forces involved in pushing and pulling a number of common objects (6a, 8e);
*c) (i) use a commercial spring balance, calibrated in newtons, to investigate for at least three different masses the relationship between the mass of each object and the force of gravity acting on the object and graph the results; (ii) measure, in newtons, several forces involved in pushing and pulling common objects (5a, 8a, 8c);
d) investigate the relationship between the distortion (stretch) of an elastic band or spring from which various masses are hung and the force exerted by such masses (6a, 8c);
*e) (i) observe situations in which forces are acting and state whether or not work is being done in the mechanical sense; (ii) determine the amount of work done, in joules, when some common objects are slid or lifted and tabulate the data (5a, 5c, 8c, 8f);
f) demonstrate that the steeper the slope of a ramp, the greater the force required to pull a given mass up the ramp (8c);
g) make and test predictions about the relative magnitudes of the starting, sliding, and rolling friction of an object on (i) a smooth horizontal surface and (ii) a rougher surface (8c);
h) observe and discuss machines, such as levers and pulleys, that (i) convert a force into another force having a different direction; (ii) convert a moving force into a faster or slower force; (iii) convert a force into a larger or smaller force (6b).

3. Applications

a) New devices have been invented to make work easier and to provide more leisure opportunities (e.g., dishwashers, electric knife sharpeners, power tools, bicycles, sewing machines, food mixers, lawn mowers).
b) Friction may be reduced to increase efficiency (e.g., through lubrication) or it may be increased to provide greater traction (e.g., through putting sand on icy roads).
c) Scientific researchers apply their knowledge of force, friction, work, and energy to make machines more efficient.

4. Societal Implications

a) The benefits of technology (e.g., easier and more productive work, more convenience and leisure) must be balanced against costs and other considerations (e.g., depletion of energy sources, waste disposal, disruption of the environment).
b) There is a need to encourage and support the development and use of machines that are energy-efficient and that are powered by energy from renewable sources.
c) Society's attitudes and decisions about issues such as employment, education, and leisure are often affected by the development of machines that reduce the need for human labour.
d) New technological applications of scientific discoveries happen so suddenly and rapidly that it is often difficult to anticipate their societal effects and to adjust to them.
e) There are beneficial and detrimental effects of technical inventions. Thomas Carroll's self-propelled combine or Armand Bombardier's snowmobile may be discussed as an example.
f) Many employment opportunities in areas such as auto mechanics, machine technology and design, agricultural mechanics, and aerodynamics depend on a thorough knowledge of mechanical principles.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) organization of data from experiments into tables and graphs;
b) activities and related reports;
c) efforts at problem solving.

6. Safety Considerations

a) Elastics or springs should be used with care and concern for the safety of others. Protective eyewear should be worn.
b) Demonstrations involving machines, if included, must be performed with ample protection.

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*See the subsection entitled "Student Activities" on page 6.

7. Possible Extensions

Some students might:

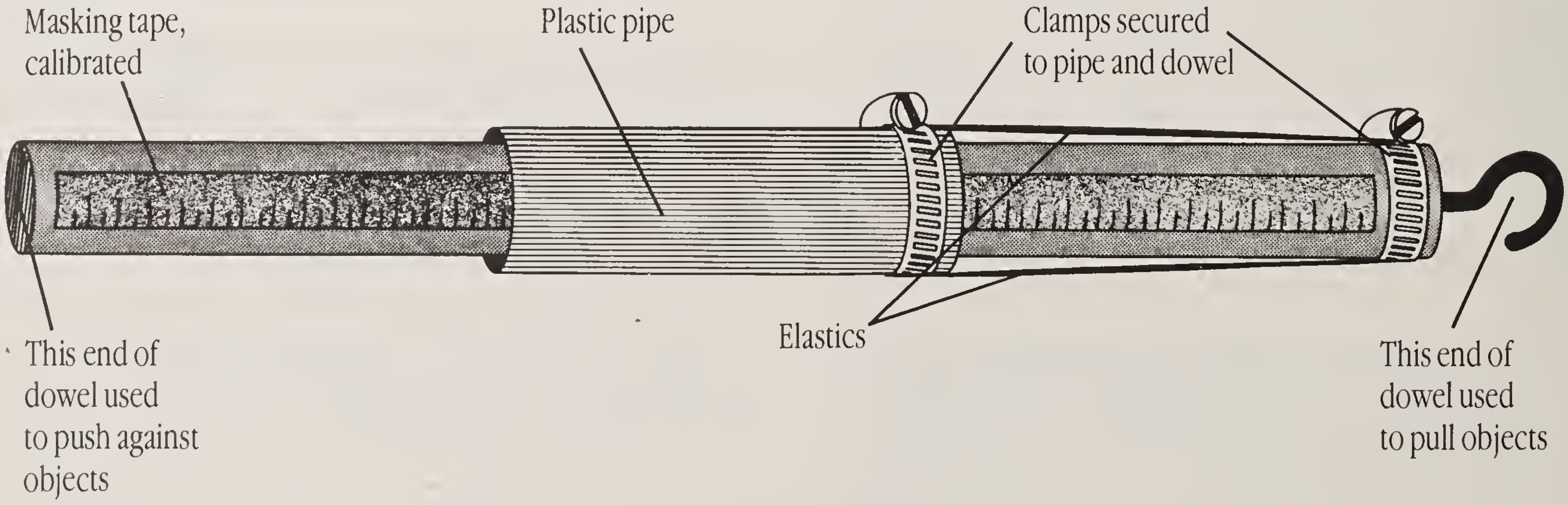
a) construct a simple force meter and calibrate it with a scale that indicates forces in newtons;
b) illustrate, using a force diagram, the forces acting on an object of known mass suspended from a string (8b);
c) classify and give examples of simple machines and build models or draw illustrations of such machines;
d) examine a newspaper every day for a week, noting references to machines and the context in which they are mentioned (e.g., economic, aesthetic, political, philosophical, or sociological);
e) gather information about the life and accomplishments of Sir Isaac Newton.

8. Some Teaching Suggestions

a) Once students have a grasp of the physical characteristic being measured, they should be encouraged to estimate before making a measurement. For example, they should try to guess the magnitude of a force in newtons or the amount of work done in joules in advance of actual measurement.
b) When describing a force, students should be able to state what the force is exerted by, what the force is exerted on, the direction of the force, and the magnitude of the force, if known (e.g., a force of about 8 N exerted *by* the elbow downwards *on* the table).
c) Students should be urged to tabulate or graph data in order to practise these processes. This unit may lend itself particularly well to the recording and organizing of experimental data by means of computers.
d) It is recommended that the formal definition of the newton (in terms of mass and acceleration) be reserved for Senior physics courses. In Grade 8 the newton should be described roughly as the force required to support two golf balls, a D-cell flashlight battery, or some other mass of about 100 g.
e) A simple force meter, capable of measuring both pushes and pulls, can be constructed for student activities (see the accompanying diagram). The two identical elastics can be changed to suit the forces being measured. The clamps must be firmly secured to prevent slippage. Hot glue from a glue gun may provide further security. The calibration on the dowel may be marked on masking tape, which can be changed when the force meter is used by different students.
f) It is important for students, when determining the amount of mechanical work done on an object, to realize that "mechanical work" is done only when the object moves through a distance. If the object remains stationary (the distance moved equals zero), no *mechanical* work is done. (*Note*: Other forms of work may be performed, such as thermal work in raising the object's temperature or physiological work in the body of the person who is trying to push the object.)

Students should ensure that the force applied to an object is pointed in the same direction as that of the object's motion and not at an oblique angle. Otherwise the determination of the work done through the use of the formula $W = Fd$ will be incorrect.

Force Meter


Masking tape, calibrated
Plastic pipe
Clamps secured to pipe and dowel
This end of dowel used to push against objects
Elastics
This end of dowel used to pull objects

Core Unit 4

Soil and Plant Ecology

Time: 16 hours

Plants are the ultimate source of food for animals and humans. The kinds of plants that can be grown and how well they will grow depend partly on soil characteristics. In order to ensure that plants will attain their genetic potential, it is usually necessary to practise soil conservation by protecting the soil from depletion and erosion. It is important for everyone to understand that the availability of food depends on the conservation and protection of the soil.

This unit may be divided into topics such as the following:

- ▶ Components of a natural environment: living and non-living
- ▶ Requirements for plant growth
- ▶ Characteristics of soil
- ▶ Soil and its influence on plant growth
- ▶ Soil communities
- ▶ Soil conservation

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a commitment to the conservation of their natural environment (2g, 3b, 3e, 4b);
b) a respect for living things (2a, 2f, 2g);
c) interest in practising good soil management (3b-3e, 4a-4c).

Skills. Students will have the opportunity to develop skill in:

a) observing and classifying non-living and living components in a terrestrial environment (2a, 2f);
b) observing the characteristics of soils (2b, 2c);
c) classifying soils according to observed characteristics (2c);
d) inferring the relationship between the characteristics of soil and the growth of plants (2e, 3a, 3b);
e) controlling variables when investigating the relationship between plant growth and non-living factors of the environment such as the soil (2d, 2e);
f) measuring the water-holding capacity of soils (2c).

Knowledge. Students will be expected to:

a) describe the effect of non-living factors such as light and moisture on plant growth (2b);
b) define or correctly use the following terms: soil, sand, silt, clay, loam, humus, erosion, fertilizer;
c) compare the sizes of particles, the water-holding capacities, and the percolation rates of various soils (2c);
d) describe how different soils affect the growth of plants (2e);
e) describe the part played by animals in the formation of soil (2f);
f) describe the living components of a specific soil community (2f);
g) describe various methods of soil conservation (2g, 3e, 4a).

2. Student Activities

Students are to:

*a) investigate the soil in a plot in the schoolyard or other local environment to identify the living and non-living components (5a, 6a, 8a, 8b);
b) investigate the effect of non-living factors such as light and moisture on plant growth (5b, 5d, 8c);
*c) investigate several soil samples to determine (i) water content, (ii) water-holding capacity, (iii) sizes of the particles, (iv) percolation rate, and (v) texture; then classify the soil samples according to their characteristics (5a, 5b, 8b);
d) investigate the relationship between soil temperature and depth (6c);

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* See the subsection entitled "Student Activities" on page 6.

*e) investigate the effect of various soil types on plant growth (6a, 8a, 8c);
f) investigate a soil community, describe the characteristics of the soil, describe the plants and animals found in the soil sample, and draw inferences about the relationships between such plants and animals (5d, 8b, 8d, 8e);
g) investigate the relationship between plant growth and soil erosion (8e).

3. Applications

a) The characteristics of a soil (along with the climate) determine what kinds of crops can be grown in a particular place.
b) In order to grow good crops, the soil needs to be properly managed.
c) Composting creates new humus to improve the quality of the soil.
d) Natural and chemical fertilizers are used to supply nutrients that are lacking in the soil.
e) Conservation authorities control the flow of water in some creeks to prevent erosion and flooding.

4. Societal Implications

a) Poor conservation practices (e.g., overgrazing, clear cutting) have resulted in the loss of good soil in many parts of the world, including Canada.
b) If good farmland continues to be used for residential and commercial development, Ontario will have to import more and more of its food and will have less to export.
c) Fertilizers in the run-off from agricultural land can pollute streams and lakes.
d) A disruption of one component in a particular environment often causes an imbalance that results in deterioration or destruction of other components of the environment.
e) Only 5 per cent of the land in Canada is suitable for farming.
f) Twenty per cent of the jobs in Ontario are related to agriculture and the agri-food industry.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) observation of the characteristics of soil and records of their observations;
b) measurement of characteristics such as the water-holding capacity of soils;
c) reports on soil classification based on characteristics observed in the activities;
d) investigation of plant growth in different soils.

6. Safety Considerations

a) Safety procedures should be established for activities conducted outside the classroom.
b) Student allergies should be considered when activities and materials are chosen.
c) Students should be taught to handle soil thermometers carefully and according to instructions.

7. Possible Extensions

Some students might:

a) conduct a soil-profile study of the schoolyard or an appropriate neighbourhood area;
b) investigate the effect of different soils in the community on the growth of different plants;
c) classify living things as producers, consumers, or decomposers and identify possible food chains or food webs in a sample environment;
d) investigate the effect of different fertilizers (natural and synthetic) on plant growth.

8. Some Teaching Suggestions

a) This unit has been designed to concentrate on the relationship between soil and plant growth because this focus allows for first-hand investigations in the classroom and schoolyard. If other resources are available, the unit could also focus on alternative appropriate environments (e.g., a wetland, pond, or woodlot).
b) The characteristics of soil should be ascertained by first-hand observation.
c) Experiments should be carried out to establish what plants need for successful growth.
d) When studying a soil community, students should divide the area being studied into small plots of equal size.
e) Erosion experiments can be readily performed with sections of eavestrough, a watering can, and a variety of soils and plants.
f) Characteristics of soils chosen for study may include the following: pH (acidity or alkalinity), texture, porosity, percolation, capillary action, particle size, water-holding capacity, humus content.

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*See the subsection entitled "Student Activities" on page 6.

Optional Unit 1

Heat and Temperature

Time: 16 hours

The causes and effects of heat are among the most basic of scientific phenomena. They are also major concerns of our society, which spends large amounts of money both to produce heat and to get rid of it. This unit provides an opportunity for students to learn about some sources of heat, observe some physical changes that occur in substances as a result of heat, and examine the way heat is transferred.

This unit may be divided into topics such as the following:

- Sources of heat
- Physical changes in substances as a result of heat
- Thermometers and temperature
- Quantity of heat and temperature
- Conduction
- Convection
- Radiation
- Heating of ice and water

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a concern about the conservation of non-renewable fuels that are used as heat sources (4d);
b) a respect for the safe use of heating equipment in the laboratory (2a, 2c, 2d, 2g, 6a, 6d);
c) objectivity and honesty in making observations during experimental work.

Skills. Students will have the opportunity to develop skill in:

a) classifying sources of heat;
b) observing length and volume changes in matter when its temperature is changed (2a, 3c, 3d);
c) recognizing mass as a variable and controlling it in a thermal investigation (2c, 8c);
d) identifying length, diameter, and kind of metal as variables in determining how a wire conducts heat (2d);
e) analysing the results of an investigation of, and making generalizations about, the effects of mass on the temperature change of a liquid exposed to a constant heat source and the effects of the kind of material on the speed at which heat is conducted (2c, 2d);
f) constructing a temperature-time graph from data obtained in an investigation (2g, 5b).

Knowledge. Students will be expected to:

a) list ways of producing heat and classify them as mechanical, chemical, nuclear, or electrical (3a, 3b, 4d);
b) describe the effect of heating and cooling on the length or volume of a solid, liquid, and gas (2a, 3c, 3d);
c) describe how a liquid thermometer is made and how it is calibrated (2b, 8b);
d) state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius (2b);
e) state that the amount of heat a liquid contains at a certain temperature depends on the kind of liquid and its mass (2c);
f) correctly use the terms *heat conductor* and *heat insulator* (2d, 3f, 3h, 4c);
g) use a diagram to illustrate convection in a liquid or a gas (2e, 3g);
h) describe changes in temperature in an ice-water mixture as the ice melts and the resulting water is warmed almost to the boiling point (2g).

2. Student Activities

Students are to:

a) observe the changes that occur in length or volume with changes in temperature when solids, liquids, and gases are heated or cooled (8a);
b) examine a thermometer and observe how the scale is subdivided, explain why it has a large bulb and narrow bore, and explain how the fixed points are determined (8b);
*c) investigate the effect of the mass of a liquid on temperature change, using a constant heat source for a given period of time (8c);
d) observe and compare the speed of heat conduction in different materials;
*e) observe convection currents in water and air;
f) measure temperature changes in identical materials of different colours when they are placed in the sun or under a heat lamp;
*g) measure temperature changes as ice is melted and the resulting water is warmed almost to the boiling point (5b, 8d).

3. Applications

a) Moving parts in cars, sewing machines, bicycles, and all high-speed machines are lubricated and, in some cases, cooled to prevent damage from overheating and expansion.
b) Fires resulting from spontaneous combustion in stored hay and oily rags can be prevented if there is enough ventilation to prevent the heat from accumulating.
c) Expansion joints are put in bridges to prevent buckling when the bridges are heated in the summer and their steel structural members expand.
d) Overflow tubes or containers are connected to car radiators to allow the cooling fluid to escape when it becomes hot and expands.
e) Large bodies of water such as the oceans and the Great Lakes have a moderating influence on climate, because the water absorbs and holds large quantities of heat in summer and releases the heat in winter.
f) Insulating handles are used on devices such as cooking utensils, soldering guns, and irons because a metal handle would get too hot to hold.
g) Home-heating systems may make use of convection or radiation to spread the heat through a house.
h) Insulating materials are used in buildings to reduce heat loss and gain.

4. Societal Implications

a) The removal of heat produced by industrial processes and by the generation of electricity can cause heat pollution of large bodies of water. Industry is learning how to use such waste heat productively.
b) Some oil reserves are consumed in the lubrication and cooling of machinery and industrial equipment. The disposal of the used oil is an environmental challenge.
c) As the price of fuel rises, efforts are being made to produce and install better insulating materials and to improve our insulating techniques.
d) As our non-renewable energy resources are depleted, we will have to develop techniques to make better use of alternative energy sources.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) laboratory work, including the use of numerical data to show how mass relates to temperature change during heat transfer;
b) oral and written reports, including a time-temperature graph.

6. Safety Considerations

a) Heating devices are to be used only on flat horizontal surfaces. During open-flame experiments a multipurpose fire extinguisher and a fire blanket should be available. The use of hot plates is recommended.
b) Protective eyewear must be worn when liquids are heated with open flames. Loose hair and clothing must be tied back.
c) Volatile liquids like alcohol must be stored in approved containers. Such containers are not to be removed from the storage area.
d) Special precautions should be taken to avoid burns when hot containers and liquids are being handled.

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*See the subsection entitled "Student Activities" on page 6.

7. Possible Extensions

Some students might:

a) read about a topic such as solar heating, CANDU reactors, microwave ovens, or radiant heaters, and write a report on the topic;
b) calculate the relative thermal expansion of different solids and liquids and gather information about the reasons for thermal expansion;
c) determine the effect of the colour of an object on how well it absorbs and emits radiant energy;
d) test the insulating and conducting properties of different materials;
e) determine the effect of distance on the temperature change caused by radiant energy;
f) determine the effect of a ceiling fan on heat distribution in a room.

8. Some Teaching Suggestions

a) The teacher or students can demonstrate the heating of materials to show thermal expansion. Cooling with ice can be used to demonstrate the changes in volume of liquids and gases.
b) If an uncalibrated thermometer is available, students can be shown how the fixed points are established by using melting ice and boiling water and dividing the interval between the two recorded temperatures into equal increments. The expansion of the liquid in the thermometer is an indicator of the heat level of the substance.
c) Students should know that temperature alone is not an indicator of the amount of energy in a substance. A 10 kg mass of water at 80°C contains more heat than a 1 kg mass of water at 80°C.
d) Ice can be melted in a hot-water bath as well as over a flame. Although the hot-water-bath method is slower, it will yield better results, because it will not make hot spots in the ice and water mixture.

Optional Unit 2

Adaptations

Time: 16 hours

The study of the relationships among plants, animals, and their environment shows many ways in which organisms are adapted to a particular habitat. The adaptations may be structural, physiological, behavioural, or some combination of these three. It must be stressed that individual organisms do not adapt to suit the environment; rather, they survive because they have characteristics that suit them to a particular environment. Since the species that is best suited to its environment is the most likely to survive and because its offspring inherit its characteristics, that species will tend to prevail. In this unit students will examine a variety of organisms, both plant and animal, to observe and compare how various characteristics are adapted to a particular environment.

This unit may be divided into topics such as the following:

- The adaptation of structures, functions, and habits
- Physical aspects of the environment
- Adaptations of plants
- Adaptations of animals
- The role of adaptations
- Basic needs of all organisms

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a concern for preserving the variety of living things that exists (8e, 8g, 8h);
b) a commitment to the preservation of the delicate balance in nature (8f, 8h);
c) an appreciation of the need for stable environments to ensure the continued existence of many species (8b, 8e);
d) a concern for the fact that, when people change the environment of a species, it may either harm or help the species' chances of survival (4a-4c).

Skills. Students will have the opportunity to develop skill in:

a) observing characteristics of several plants and animals that enable them to adapt to their environment (2a, 2c);
b) inferring that certain adaptations of plants and animals are for specific purposes (2a-2d);
c) testing their inferences about the adaptations of plants and animals (2a, 2c, 2e);
d) predicting the particular environmental requirements of an organism after observing its unique characteristics (2e);
e) hypothesizing as to why certain species have become extinct while others have become abundant (2d);
f) designing experiments that involve the construction of terraria and aquaria as habitats for plants and animals (2b).

Knowledge. Students will be expected to:

a) explain adaptation;
b) describe some attributes of plants that enable them to adapt to a particular environment, such as a desert, woodland, or pond (2a);
c) describe some attributes of specific animals (e.g., dragonflies, yellow perch, leopard frogs, beaver, polar bears) that enable them to adapt to a specific environment (2c);
d) list several things that are physical necessities for all organisms (e.g., air, heat, water, food);
e) list two kinds of behaviour that are adaptations to the environment (8e).

2. Student Activities

Students are to:

*a) examine the characteristics of plants from particular environments (e.g., desert cacti, woodland ferns, pond lilies) to determine how they are able to adapt to those environments (6b, 6d, 8a, 8d, 8e, 8h);
b) construct and maintain a desert or woodland terrarium or an aquarium (8b, 8g, 8h);
*c) examine the external characteristics of specific animals (e.g., dragonflies, perch, beaver) to determine their special adaptations to their environment (6e, 8a, 8d, 8e, 8h);
*d) study and prepare a brief report on the relationship between adaptation and one of hibernation, migration, or communication among members of the same or different species (5c);
e) examine other plants and animals and predict the type of habitat that they would require (8h).

3. Applications

a) Landowners who want to attract birds or wild animals can do so by planting trees or shrubs that will provide food and shelter for those animals.
b) Gardeners, farmers, and landscape architects have to provide a suitable environment for the plants they want to grow.
c) Homeowners who want to plant a garden must choose plants that are adapted to the conditions in their gardens or change the conditions or do both.
d) Farmers choose crops and livestock on the basis of the land and weather conditions in their area.
e) Plant- and animal-breeding programs are often designed to develop characteristics that suit particular environmental conditions.

4. Societal Implications

a) Many plants and animals are in danger of extinction because their habitat is being destroyed by urban sprawl, cottages, and other human activity.
b) Human activity sometimes unintentionally provides a habitat suitable for a particular species, which may then multiply rapidly. For example, sandy ground that is created beside large lakes by landfill provides ideal nesting grounds for gulls.
c) Pollution can change the conditions of an environment, thereby causing species to become scarce or to die out because they cannot tolerate the change.
d) Plants and animals that adapt to herbicides and pesticides become very difficult to control.

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*See the subsection entitled "Student Activities" on page 6.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) performance of observation tasks;
b) laboratory records and science notes;
c) reports on the role of adaptation as required in student activity 2d.

6. Safety Considerations

a) The handling of plants and animals must be carefully supervised by the teacher.
b) In work with plants, the release of pollen or spores into the classroom environment must be avoided.
c) The teacher should find out if any students have allergies and caution them to avoid plants and animals that may be allergenic.
d) Students should be warned about any poisonous plants they are likely to encounter.
e) Live animals are not to be harmed in any way. The teacher should be familiar with the procedures outlined in section 9.3 of Part 1 of this guideline.
f) Preserved specimens should be washed thoroughly before they are handled.

7. Possible Extensions

Some students might:

a) increase the variety of plants and animals in their study of this unit to add interest and gain a greater understanding of the wide range of adaptations;
b) examine one or more species of carnivorous plants to observe their unique attributes;
c) examine the surrounding neighbourhood to see how habitats suitable for various plants and animals might be maintained, restored, or established;
d) take part in bird counts or surveys conducted by a nature group.

8. Some Teaching Suggestions

a) Other plants and animals may be substituted for those mentioned in the student activities. However, it is important to include some plants as well as both vertebrate and invertebrate animals.
b) Where possible, live plants and animals are to be observed, usually in a terrarium or aquarium. The larger animals may be observed at a zoo or game farm.
c) Preserved specimens, models, films, study prints, filmstrips, posters, videotapes, computer programs, and so on can be important resources for this unit.
d) This unit can be done at any time of the year, but spring or early fall would allow for the best possible field studies.
e) Field studies and laboratory work should form a large part of the unit.
f) Student awareness of the importance of balance in the environment should be stressed, along with the other attitudinal objectives.
g) Students should take part in planning, setting up, and looking after the aquaria and terraria.
h) The importance of observing plants and animals without damaging their habitats should be emphasized. The quantities and varieties of living things obtained for aquaria and terraria should present opportunities for students to demonstrate a respect and concern for various kinds of living things.
i) Students might consider the meanings of the words *allergic* and *allergenic*. Teachers should avail themselves of opportunities to emphasize language learning and usage.

Optional Unit 3

Science Project

Time: 16 hours

This unit is the same for the Grade 8 science course as optional unit 3, "Science Project", is for the Grade 7 course. Students who have done a science project in Grade 7 should, of course, choose a different project for Grade 8.

Optional Unit 4

Locally Designed Unit

Time: 16 hours

This unit is the same for the Grade 8 science course as optional unit 4, "Locally Designed Unit", is for the Grade 7 course. A different set of topics than those selected for Grade 7 should, of course, be provided.

Appendixes

A: Science Courses and Their Course Codes
B: The Table of Contents of Part 1

Appendix A

Science Courses and Their Course Codes

The secondary school guideline courses in science authorized under this document have the following course codes:

Science, Grade 9, Basic Level	SNC1B
Science, Grade 9, General Level	SNC1G
Science, Grade 9, Advanced Level	SNC1A
Science, Grade 10, Basic Level	SNC2B
Environmental Science, Grade 10, General Level	SEN2G
Science, Grade 10, General Level	SNC2G
Environmental Science, Grade 10, Advanced Level	SEN2A
Science, Grade 10, Advanced Level	SNC2A
Science, Grade 11, Basic Level	SNC3B
Applied Biology, Grade 11, General Level	SBA3G
Applied Chemistry, Grade 11, General Level	SCA3G
Environmental Science, Grade 11, General Level	SEN3G
Biology, Grade 11, Advanced Level	SBI3A
Chemistry, Grade 11, Advanced Level	SCH3A
Science, Grade 12, Basic Level	SNC4B
Environmental Science, Grade 12, General Level	SEN4G
Geology, Grade 12, General Level	SGE4G
Applied Physics, Grade 12, General Level	SPA4G
Environmental Science, Grade 12, Advanced Level	SEN4A
Geology, Grade 12, Advanced Level	SGE4A
Physics, Grade 12, Advanced Level	SPH4A
Technological Science, Grade 12, General Level	STE4G
Biology, OAC	SBI0A
Chemistry, OAC	SCH0A
Physics, OAC	SPH0A
Science in Society, OAC	SSO0A

The following general rules govern science course codes:

- All science course codes begin with an **S.**
- **SNC** identifies a course that has only the name "Science".
- Where one word other than "Science" describes the course, the first two letters of that word follow the **S** (e.g., **SBI** means "Science, Biology" or simply "Biology"; **SEN** means "Science, Environmental" or "Environmental Science").
- Where two words other than "Science" describe the course, the initial letters of those words are used (e.g., **SCA** means "Science, Chemistry Applied" or simply "Applied Chemistry").
- The fourth character in the course code, **1**, **2**, **3**, **4**, or **0**, represents Grade 9, 10, 11, 12, or an OAC respectively.
- The fifth character represents the level of difficulty: **B** for basic, **G** for general, or **A** for advanced.

For further information on course codes, refer to the *Manual for the Common Course Code* (Toronto: Ministry of Education, Ontario, 1986).

Appendix B

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Appendixes

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